SCIENTIFIC AMERICAN

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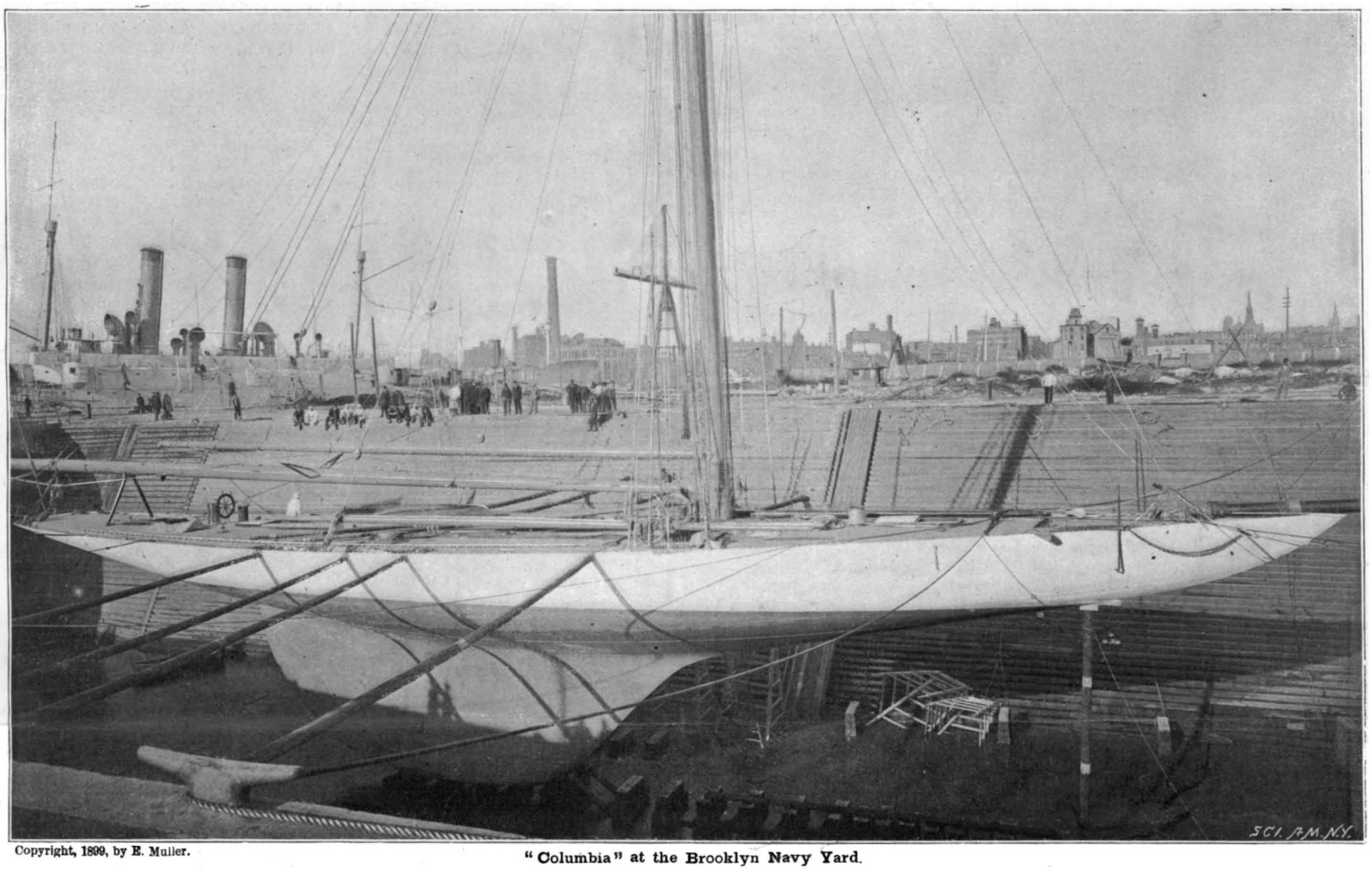

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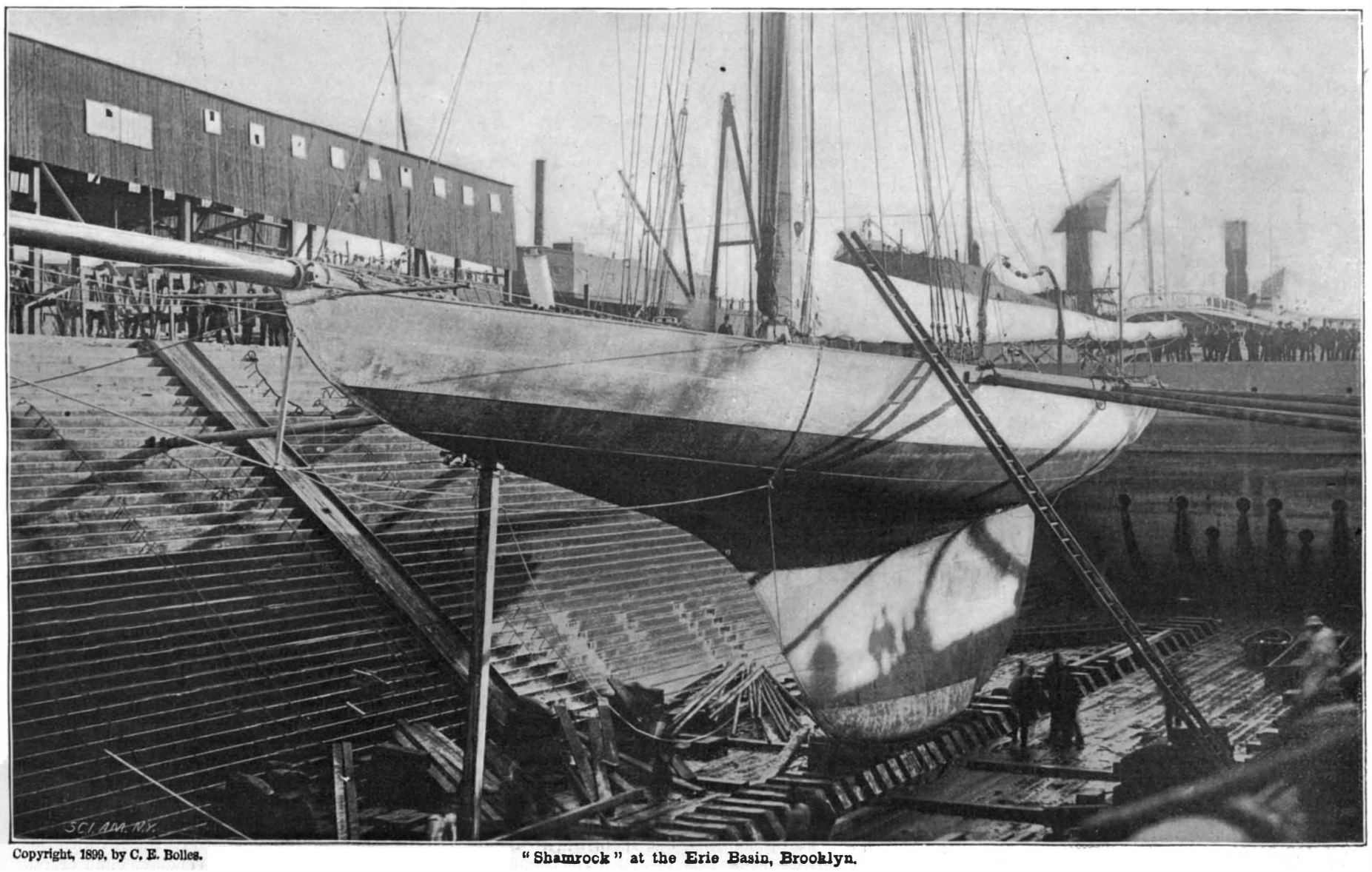
"Columbia" at the Brooklyn Navy Yard.



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"Shamrock" at the Erie Basin, Brooklyn.

FIFTY YEARS OF INTERNATIONAL YACHT RACING.—[See page 248.]

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NEW YORK, SATURDAY, OCTOBER 14, 1899.

MARCONI TELEGRAPHY.

Through the enterprise of The New York Herald, the public has been made acquainted in a very practical way with the great advantages which result from the use of what is now popularly known as the "Marconi system of wireless telegraphy." The world-wide interest which is being taken in the present international yacht races renders the instant transmission of the progress of the race a matter of actual importance, and the saving of a few hours' time, which is rendered possible by wireless telegraphy, led to the bringing of Mr. Marconi to this country in order that he might report the races from a steamer which accompanies the yachts over the course.

On the day of the first race the large ocean-going steamer "Ponce" was equipped with a slender mast which extended some 50 feet vertically above the foremast of the vessel. A similar mast was carried by the Mackay-Bennett cable steamer, which was anchored at the starting point, off Sandy Hook, and had temporary connection with the submarine cable at that point. The Marconi apparatus was installed in the chart room on each vessel, and the progress of the yachts was telegraphed at intervals of a quarter of an hour from one vessel to the other. From the steamer at Sandy Hook the messages were sent to New York, whence they were distributed throughout the world. The experiment proved to be perfectly successful, and the reports contained in The Evening Telegram appeared from two to three hours sooner than those transmitted by the ordinary methods.

Marconi comes to this country fresh from the triumphs which he has scored with his system in the recent maneuvers of the British navy, where messages were flashed from ship to ship over a distance of 80 miles. It was inevitable that the great success which is attending the Marconi system should have aroused the interest, and in some cases excited the jealousy, of other investigators in the field of wireless telegraphy. Marconi himself, we have no doubt, would be the first to acknowledge that there are others who have done conscientious work in this line of investigation, and he would be perfectly willing to give full credit where it is due. The existence of the Hertzian waves was known long before this young Anglo-Italian harnessed them so successfully to the uses of modern life, and others, both before and after him, have attempted unsuccessfully to do what he has done.

We regret to note that his arrival in America has unduly excited certain holders of patents on wireless telegraphy, who believe that Marconi is receiving more credit than is strictly his due, and claim that the credit is not his, but theirs. This has been the history of all great epoch-marking inventions, and the recent extraordinary attempts to prove that the Bessemer steel process was misnamed, and that a certain Kelly had actually done the work and should receive the credit, will be fresh in the minds of our readers. We note in this connection that a certain section of the press is responsible for the statement that Professor Dolbear, of Tufts College, is "the discoverer of wireless telegraphy," and that he is so far resentful of Marconi's invasion of his domain that "a conference of lawyers has been held," and instructions have been given to "serve notice that he (Marconi) would be restrained from using his system of wireless telegraphy in the United States."

Whatever may be the merits of this controversy, we are satisfied that it would be as easy to sweep back the tide with a broom as to prevent the system of telegraphy which has just done such good work off New York Harbor and with the English fleet from becoming forever identified with the name of the man who first brought wireless telegraphy to a practical and useful consummation.

"COLUMBIA" AND "SHAMROCK" IN DRY DOCK.

Next to the races themselves there is no event connected with a contest for the "America" cup which equals in public interest the docking of the yachts and the consequent disclosure of their underwater form; for it is in the model of the modern yacht and not in her sail plan that the genius of the designer of to-day is most apt to reveal itself.

The secrecy which surrounded the construction of the competing yachts had awakened more than usual curiosity as to the form and construction of the two boats. It was naturally believed that the extraordinary precautions which were taken to prevent the public from getting even a hint as to the beam, draught, or lines of the contestants was due to some marked departure from existing practice, if not from established theories. "Columbia" was launched at night; "Shamrock" in petticoats; and the Sphinx was not more silent on the questions which were in everyone's mind than the gentlemen who were responsible for the "America" cup champions of the year 1899.

It must be confessed that the docking of the yachts has furnished a great surprise; for where the public was looking for novelties it found in the case of both challenger and defender nothing more nor less than a typical, up-to-date yacht. The characteristics of the type, as represented in a "ninety-footer," are a beam of about twenty-four feet and a draught of twenty feet; some eighty to ninety tons of lead on the keel; a displacement of from one hundred and forty to one hundred and fifty tons; and a sail area of about thirteen thousand square feet. The materials of construction will include nickel steel for the framing, plating of some non-corrodible bronze, and hollow steel spars of great strength and lightness.

Now if we take the "Columbia" and the "Shamrock" as examples, we find that they conform with wonderful closeness to the above specification—at least as far as dimensions and materials are concerned. In the matter of model, both above and below the water line, there are, it must be admitted, very marked differences between the two boats; but in no sense can either be called a surprise. They possess all the characteristics which distinguish a Herreshoff from a Fife design, and certainly they present no startling novelties, hitherto unknown or untried by yacht designers. "Columbia" is an improved "Defender," "Shamrock" an enlarged and improved "Isolde."

Compared with the champion of 1895 "Columbia" is in every way a more beautiful yacht. The three views which we present were taken when she was in the large No. 3 dry dock at the Brooklyn navy yard, and they show what exquisite beauty can be given to the underwater form even of a deep finkeel vessel of this extreme type. The variations from "Defender" are all in the direction of securing a finer form, one that can be driven through the water with less expenditure of power. While the beam is wider and the lead placed lower, the overhangs and the waterline length are considerably larger and the entrance and delivery are finer than in the older boat. The hull proper is deeper, and the whole model is a further departure even than was that of "Defender" from the old skimming-dish type of hull. The construction, moreover, is more wholesome than that of "Defender"; for the treacherous aluminum alloy in frames, deck beams, and topsides has given place to more reliable steel and bronze, with the result that our '99 champion will be prepared to cross the ocean and try her paces in the regattas of the Mediterranean and the Clyde.

In "Shamrock" the English have sent over their first out-and-out racing machine. She is the lightest yacht of her size ever constructed, not even excepting "Defender"; for in her aluminum deck alone she has saved about 5,000 pounds of weight as compared with that yacht. Perhaps the most striking features of the boat are her unusually lofty topsides (her freeboard is over 5 feet as against 3½ feet in "Columbia") and her deep draught of 21½ feet. Her midship section shows a considerable flare above the waterline, and this, combined with her wide beam, high freeboard, and deep lead, gives her great sail-carrying power, especially in a strong wind. The boat has rather a hard bilge and a flat floor, which rounds into the fin proper with a short hard curve. When afloat she looks to be much bigger than she is, most of the boat being above the waterline, and as a glance at the midship sections of the two vessels will show, she approaches more nearly to the true finkeel type than does "Columbia." The sheer-plan shows that the "Shamrock's" keel is much the longer (at least 8 or 9 feet); hence the center of gravity of the lead is lower, and this coupled with the fact that her draught is deeper by 1½ feet makes it certain that the center of gravity of the lead is at least 3 feet deeper below the waterline in the English boat. Other things being equal, this means less lead for the same stability. At the same time the longer keel involves the addition of about 220 square feet of wetted surface, and a slower boat in light winds. In heavy winds, and indeed in any wind, the longer keel should make "Shamrock" a better boat in climbing to windward when close-hauled.

At the present writing there have been two unsuccessful attempts to sail the first race of the series. The winds were too light and fickle to afford any reliable test of the yachts; for although "Columbia" was the leading boat during the greater part of the contests, on both occasions "Shamrock" was slightly in the lead when the race was called off. In spite of the fact, however, that the challenger showed unexpected light-weather qualities, it seemed to us that the performance of the two yachts indicated the "Columbia" to be the better all-round boat under the prevailing conditions.

PROPOSED CYCLE PATH ACROSS THE BROOKLYN BRIDGE.

The earnest efforts which are being made by the great body of wheelmen in New York city and Brooklyn to secure a separate cycle path across the bridge for their exclusive use are perfectly reasonable and deserving of the strongest support. The day has gone by when the efforts of wheelmen to secure proper facilities on our thoroughfares can be regarded as an endeavor to secure favors for a small minority at the expense of the general public. The enormous increase in the number of riders in the last few years has been accompanied by a demand for special provisions for their safety and convenience, and in nearly every case they have gained what they sought. Wheels are now carried as baggage free of charge on our railroads, and special protection is afforded in some of our cities by specially-trained squads of policemen.

However, it is not with the legal or ethical side of the question that we are concerned so much as its practical and mechanical aspects. As far as the structure of the Brooklyn Bridge is concerned, there is not the slightest reason why a cycle path should not be built across it. If the path were provided, the additional weight would be so insignificant compared with the total dead and live loads of the structure as to be a practically negligible quantity. Obviously the best location would be above one of the pairs of interior stiffening trusses through which tracks of the bridge trains are laid. Light steel floor beams could be laid across the top chords of the trusses, and these, together with the plank flooring and the light hand rail, would weigh but little per foot and would add practically nothing to the existing strains in the bridge.

It seems that the problem at present, as stated by the bridge engineers, is to provide a suitable terminal at the New York end of the structure, but it is certain that in view of the light nature of the necessary construction and its comparative narrowness, some way out of the difficulty could be found which would neither encroach seriously on the present space, nor present an objectionable appearance judged from the æsthetic point of view.

The opposition of the engineers of the bridge to the addition of any further weights, however small, to the structure is natural, and on general principles commendable. It is their duty to see that the limits of safety are not exceeded nor even too closely approached. At the same time we cannot but remember that the running of the trolley cars across the structure was at first strenuously opposed and pronounced to be neither practicable nor safe. The car tracks, however, have now for a long period been in operation, and have proved to be of inestimable service to the public. The bridge has suffered no harm from the addition, and we believe that as long as the proper headway has been observed, the safety of the structure has been in no degree jeopardized.

AMATEUR INVESTIGATIONS WITH A TESTING TANK.

In the current issue of the SUPPLEMENT is published the first part of an article which will be of the greatest interest to those of our readers who are interested in the matter of boats and boat sailing. The author of the papers is an amateur yachtsman with more than a quarter of a century of experience, who set out to determine for himself, by practical experiment, many questions which are supposed to be theoretically pretty well established. To determine the best model of hull and the influence of the various elements of beam, draught and general form on speed, the author of the paper constructed a small towing tank equipped with a dynamometer and a set of experimental models, the whole of which, including the tank, could be placed in a fair-sized sitting room. It is true no attempt was made to secure anything like the scientific accuracy of a full-sized shipbuilder's model basin; but the simplicity and cheapness of the apparatus, and the agreement of the results in a general way with those obtained in a full-sized tank, render the experiments of extreme interest and certainly of value.

Any amateur who wishes to test for himself the many vexed questions connected with the designing of a boat can do so at a small expense by following the methods described in the article referred to. The question of the best form of sails will be taken up in the second part of the article, which will be published in the SCIENTIFIC AMERICAN SUPPLEMENT of next week. The writer claims to have been the originator of the theory that a perforated sail would, under certain conditions of wind, do better work than a sail of the ordinary pattern. The principle of perforation was tried in a lengthy series of experiments with sails built on the principle of the Venetian blind or per-

haps, to speak more accurately, of the modern aeroplane. While the very idea of splitting the sail to let any portion of air pass through is radically opposed to accepted theories on the subject, Mr. Burnham, the author of the experiments, states that on certain points of sailing the slotted sail showed superior driving power to one of the standard type.

STATISTICAL DUPLICATION.

Statistician Powers, of the Census Bureau, is making special efforts to plan a successful campaign whereby full agricultural statistics shall be gleaned for the coming twelfth census. The law specifies only the crops of 1899 as those to be reported; but, as the census agents will not take the field till after June 1, 1900, and the bulk of the great crops of 1899, especially in the South, will be harvested and marketed long before that time, growers will be expected to furnish statistics to the enumerators, some of which will be quite a year old. It is desired by the Bureau that growers be prepared to do this, and to that effect it is using every channel to notify them of the necessity of being thoroughly posted as to what they grew and marketed, and the prices obtained therefor.

The strange part of all this is that our Department of Agriculture has a most efficient, long trained force for this very purpose; and not only their annual but their monthly statistics are the most complete of anything of the kind attempted in any country. Yet this working force will be entirely ignored, its records passed as of no avail, and exactly the same work and results as theirs will be attempted with comparatively raw, untrained recruits. That such statistics will differ from, and must be of considerably less scientific value than, those of the Department of Agriculture goes without the saying.

We call attention to this just at this time in the hope that it is not yet too late for the press of the country to take the matter up and induce a change of some magnitude to be made in the plans of the Census Bureau. General Merriam is sure to find the funds at his disposal far from what he will require for special features of great value to all students of commerce and political economy, if thousands of dollars are thus used to duplicate the work of the Department of Agriculture.

The same thing might also be well illustrated by reference to the duplications of work now being well done by the Treasury, Interior, Post Office and War Departments.

EXCHANGING FISH FRY WITH EUROPE.

Many tourists who will attend the Paris Exposition next summer need not be surprised if they find on the bills of fare of the leading European hotels such items as "American black bass," "American salmon," or "American muskalonge." It should not be hastily concluded that these items are put there for deceptive purposes, or that they refer to canned or dried American fish. They are in reality true statements of facts, and indicate the growth of our fishing interests under the wise and progressive supervision of the United States Fish Commission. During the past summer American fish, fresh from the water, appeared on the tables of European hotels devoted specially to catering to American tourists.

In order to appreciate the full meaning of this, it is necessary to glance at a feature of the work planned years ago by the Fish Commission. Almost thorough and painstaking effort was made then to collect all possible facts concerning our food fishes as a preliminary to adopting adequate methods for protecting and propagating young fry. This scientific study and experiment included an elaborate investigation of the food plants of fish in inland waters, the cause of famines and years of plenty, and the relative chances of certain varieties of fish in strange waters in reaching maturity.

In propagating the young fry for restocking the streams, bays, and rivers, experiments were made to see how well they thrived in waters far removed from their natural habitat. This experiment proved of great commercial value to the country. Inland waters that were almost destitute of fish are now teeming with millions of artificially propagated fry. In some of the new waters they have been transplanted to, the food fishes have been found to thrive better than in the streams where they were found. The extension of this work to foreign waters was anticipated by the Fish Commission years ago purely as a scientific test. Consequently when they received intimations from leading ichthyologists abroad that an exchange of native fry would be agreeable, preparations were immediately made to send our fish to European countries

The first experiment was made in Scotland with our landlocked salmon. The inland waters of Scotland presented conditions somewhat similar to those in which our salmon loved to disport, and besides there was a species of Scotch salmon native to the streams and lakes of that land. Young fry of our landlocked salmon were shipped to Scotland some ten years ago, and in that time they have multiplied rapidly, much to the detriment of the Scotch salmon. The American salmon proved larger and stronger than their native cousins, and the Scotch salmon is almost threatened with extinction by the growing rapacity and multiplication of the American landlocked salmon. On the whole, however, this is not to be regretted, for the American species furnish more and better food than the Scotch salmon.

A shipment of American black bass fry was made to France for stocking the rivers and streams, and, like the American salmon in Scotch waters, they have flourished so marvelously that to-day they are quite common articles of diet at the French hotels and restaurants. The French streams, since the introduction of the American bass, have doubled in their productive value, and there is every reason for the French anglers to be grateful to our American Fish Commission for stocking their waters with a new species of food fish. The French streams were practically deserted when the fry were introduced, and they had little difficulty in taking quick and complete possession of the waters.

Other varieties of fish have been shipped to France and other countries as scientific experiments. The American rock bass has been introduced in several English streams, and the American brook trout is today in flourishing condition in the clear, cold streams of Russia and other northern countries of Europe. The waters of Switzerland abound with many of our common river and brook fish, which make the angling there superior to anything in the past. It is even reported that the fine American muskalonge has found a satisfactory home in the Rhine and Danube Rivers.

In return for these American food fishes we have received few foreign fry that have proved of any particular value. The attempt has been made to introduce the best of the European fish in our waters, but as a rule American fish are superior to any that Europe can produce, and we have not been greatly benefited by the exchange. The Scotch salmon has been tried here, but holds out little promise of success in waters where the American salmon lives There is reason to believe that we will be more benefited in introducing the young fry of South American fish in our northern waters than any that can be brought from Europe. The condition of ichthyology in the countries south of us, however, is such that it is difficult to secure the fry without sending an expedition after them. At present it seems as if we had sufficient varieties of fine, toothsome fish in our waters to satisfy the most fastidious epicure; but it is possible that in its scientific investigations with the fish from all parts of the world, the commission may some day add to our fish diet some new species that will prove of enduring value. Meanwhile, the scientific search after facts concerning the food and habits of our American fish at home and abroad will enable the commission to handle the problem placed before them with more assurance of success. In the comparatively few years it has been laboring in the field it has accomplished results that are well known, and of value alike to the consumer and the sportsman or professional fisherman. There are few scientific studies and experiments that show practical results sooner than that of fish culture. G. E. W.

THE MINING INTERESTS OF AFRICA.

The mining interests of Africa, especially the wonderful gold and diamond fields, are particularly interesting at the present time owing to the unsettled conditions in the Transvaal. Much of the recent rapid development of Africa, especially in the southern part, is due to the discovery and development of extremely valuable mineral deposits, particularly of gold and diamonds, and incidentally it may be mentioned that the iron, coal, and other mineral deposits of South Africa give great promise when the wealth-seekers find time to turn their attention to industries which are less speculative.

The gold and diamond mines are wonderfully profitable. The Kimberley mines, which are located in British territory just outside the boundaries of the Orange Free State and about 600 miles from Cape Town, now supply about 98 per cent of the diamonds of commerce. The existence of these mines as unknown prior to 1867, and in the brief period since their discovery $350,000,000 worth of rough diamonds have been taken from the Kimberley mines, and the stones were easily worth double this sum after cutting. This enormous production would have been greatly increased but for the fact that the owners of the mines in the vicinity formed an agreement by which the annual output was so limited as to meet, but not materially exceed, the annual consumption of the world's diamond markets. The supply is so plentiful and so comparatively inexpensive is the work of diamond digging that the industry has almost ceased in other parts of the world since the South African mines entered the field.

Equally wonderful and promising are the great "Witwatersrand" gold fields of South Africa, located in the South African Republic, better known as the "Johannesburg mines." The strip of territory a few hundred miles long and a few miles in width to which this name is applied was, a few years ago, considered nearly worthless, useful only for the pasturage of cattle and sheep. According to our Treasury Bureau of Statistics, gold was discovered there in 1883, and in the next year the gold production was about $50,000. The output increased with startling rapidity. The amount of gold mined in 1888 was $5,000,000; in 1889, $10,000,000; in 1892, over $20,000,000; in 1895, over $40,000,000; and in 1897 and 1898, $55,000,000 each year. This wonderful development naturally attracted great attention to South Africa and drew thither thousands of people in the hope of making fortunes rapidly. The mines, however, cannot be successfully worked except by the use of costly machinery, and while they have been extremely productive where machinery has been used, they were not of such a character as to make hand or placer mining profitable, as was the case in California and Australia and other places. The gold production of the "Rand," since 1884, has been over $300,000,000, and careful surveys of the field show beyond question that $3,500,000,000 in gold can probably be extracted, while the large number of mines which have been located in adjacent territory, particularly in parts of Rhodesia, give promise of additional supplies, so that it seems probable that South Africa will for many years continue to be as it now is, the largest gold producing section of the world. Recent discoveries tend to the belief that these wonderfully rich mines are the long lost "Gold of Ophir" mines from which Solomon obtained his vast supplies.

RAILROADS IN 1898.

A welcome visitor to the editor's table is "Poor's Manual of Railroads for 1899." The general statistics regarding the roads for the year are most important and authoritative. The general exhibit for the fiscal year shows that the length of our railroads on December 31, 1898, was 186,809 miles, showing an increase of 1,915 miles in the year. There is in addition to the mileage already given 60,344 miles of second tracks, sidings, etc., making a grand total of 245,238 miles of track. Of this mileage, 220,803 miles of track are equipped with steel rails and only 24,435 miles have iron rails. There are 36,746 engines, 25,844 passenger cars, and 1,284,807 freight cars. The total liabilities of the companies are $11,968,751,204; the excess of assets over liabilities is $316,616,498. The total assets are $12,285,367,702. The actual number of miles of railroad operated was 184,532. The total train mileage was 905,010,232. In 1898, 514,982,288 passengers were carried and the passenger mileage was 13,672,497,664 miles; 912,973,853 tons of freight were moved. The passenger traffic earnings amounted to $272,589,591. The earnings from freight were $868,924,526. The total earnings from all sources were $1,249,558,724. The net earnings amounted to $389,666,474. The total available revenue was $494,203,378.

These figures show what an enormous business our railroads are doing, and our progress is all the more remarkable when we remember that it was not until 1842 that the railroad was opened from Boston to the Hudson, and from the Hudson at Albany to Lake Erie at Buffalo. In 1848 the progress made in railroad construction was so slow and unpromising that the total mileage of lines completed at the end of that year was only 5,996. In 1848, immediately after the annexation to the United States of California, the deposits of gold of marvelous richness caused great excitement, and the first movement in the construction of railways dates from the discovery of gold in California. From 1849 to 1857, 17,138 miles of railway were constructed. Then came a great commercial revulsion, which commencing in the United States swept around the world. But the nation had grown too strong, however, to suffer anything more than a temporary check. The lines of railroad which had been constructed penetrated every important portion of the country and gave high commercial value to its products. Labor everywhere was then enabled to reap, even in the midst of the great depression that prevailed, a remunerative return.

SODA WATER TO RELIEVE HUNGER.

Water charged with carbonic acid gas—in other words, soda water—is now prescribed as a palliative for hunger, especially for an abnormal sense of hunger due to disease. Says Modern Medicine, which gives us this information: "Carbonic acid gas has the singular property of lessening the sense of hunger, and may profitably be remembered in dealing with cases of diabetes in which bulimia (abnormal hunger) is a prominent symptom. The seat of hunger is found in the solar plexus. By the use of water charged with carbonic acid gas, the branches of the solar plexus distributed through the mucous membrane of the stomach are influenced in such a way that the abnormal irritation of the plexus, which is the foundation for the ravenous hunger often present in diabetes and certain forms of indigestion, may be greatly mitigated, if not wholly appeased. Water charged with carbonic acid gas may likewise be employed with advantage in many cases of hyperpepsia in which there is a sensation present in the stomach described by the patient as a gnawing sensation, 'goneness,' emptiness, etc."

Bacteria as Destroyers of Masonry.

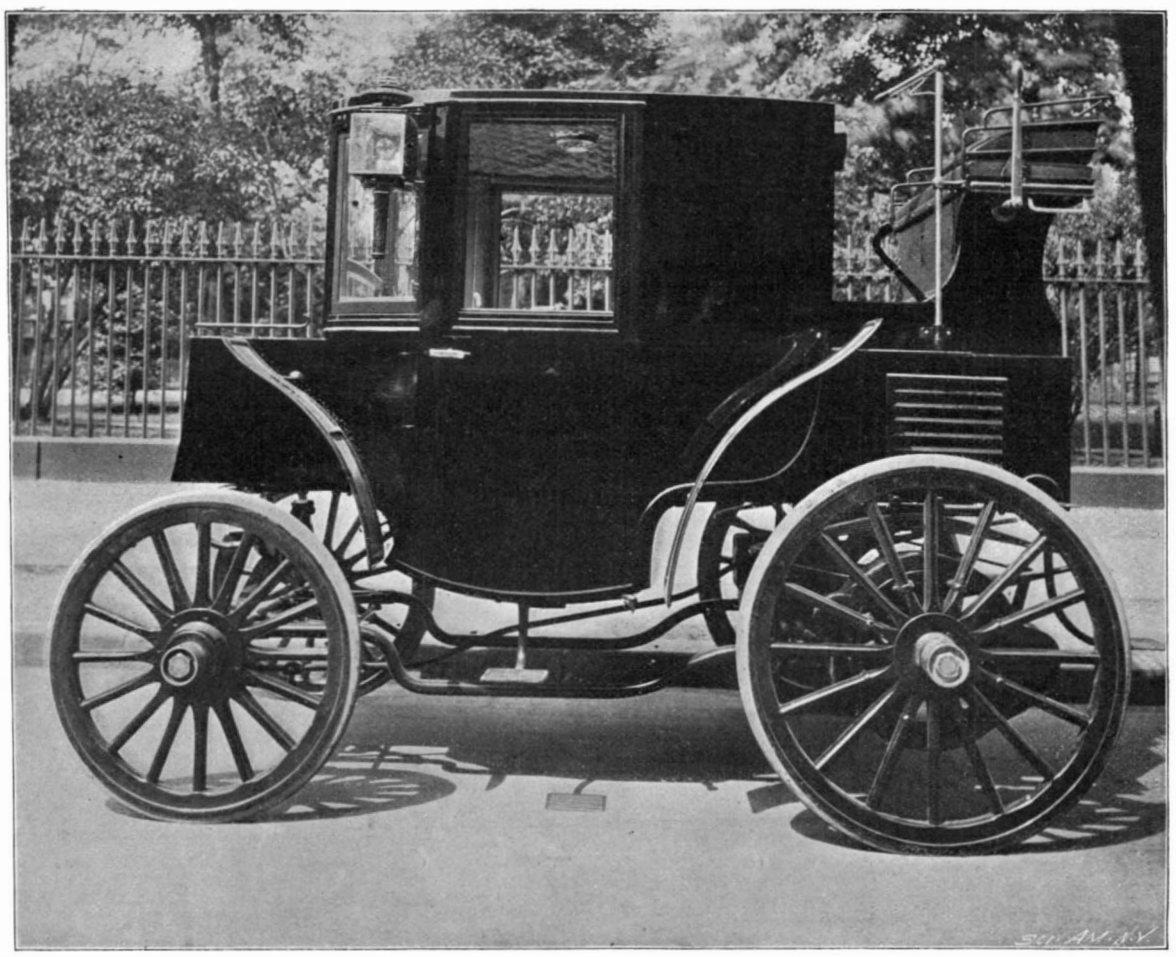
Bacteriology has shown how we may count alike upon friends and foes among the myriads of bacteria known to us, says The Lancet. The friendly species, however, are decidedly in the ascendancy, but comparatively few pathogenic organisms having been isolated and recognized. Recent researches have shown how important is the role of the bacterium in many industrial processes, especially where the production of articles of food is concerned. Ascertained facts would seem to teach that bacteria after all may serve us as tiny engineers who can perform stupendous work when associated in myriads, so long as they are placed under a favorable environment. The disposal of sewage by purely bacterial agencies, which under suitable conditions convert an offensive material into simpler and innocuous materials, is perhaps the best case in point. But the disintegrating action of bacteria, though perhaps an indirect one, must, according to recent observations, be reckoned with as a source of mischief. At first sight it would seem hardly possible for bacteria to be concerned in the breaking down of a stone wall, yet such would appear to be the case, according to some ingenious observations directed to the nature of the decay of cement. The gradual disintegration of the cement mortar used in water supply reservoirs is one of the serious troubles met with by water engineers, and a trouble which so far they have not been able to avoid with any measure of practical success. Hitherto this action was supposed to be the result of the solvent property of carbonic acid and other mineral substances commonly present in a water supply. The cement gradually disintegrates and becomes a kind of mud which slowly detaches itself. This strange process is due to the action of none other than that bacterium known as the nitrifying organism. An examination of the mud shows it to be teeming with these organisms. The organism, however, cannot flourish in the absence of nitrifiable pabulum. In its presence, however, nitrous acid is produced, which leads most probably to the disintegration of the cement lining of the water reservoir. The nitrifying organism is the one upon which so much depends in the purification of sewage and effete matters. On this account its growth should be encouraged, and it is curious, therefore, to find that the organism appears as an objectionable factor in the attempt to supply and store an abundance of pure water for drinking purposes.

A NEW RIKER ELECTRIC VEHICLE.

A few months ago we illustrated an electric two-seated open surrey built on the Riker system. Since then an improved form of an electric demi-coach has been constructed, illustrated in the accompanying engraving.

In designing this vehicle Mr. Riker had in mind the needless present custom of locating the driver in front of the vehicle. His idea is to give the occupants a free unobstructed view of the road at the same time protect them, in case of accidental collision, by locating half of the storage battery in the front box-like compartment and the other half in the rear under the driver's seat. This design gives the carriage a symmetrical and well-balanced appearance. The controller lever, steering lever and foot brake are clearly shown attached to the driver's seat. This is wide enough to hold two persons, one for an attendant to open the carriage doors and the other the operator. The vehicle is steered by the movement of the front wheels, connected by a rod to the rear steering lever.

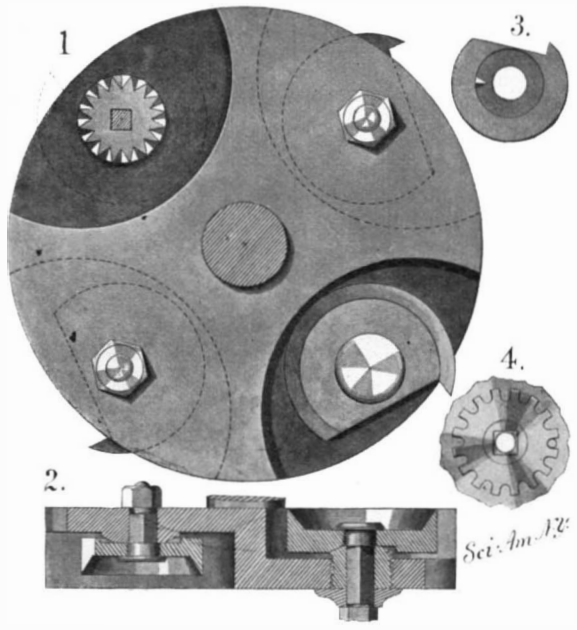
The coach will carry four persons inside, has a full glass front, an electric light in the roof and exterior lamps. It is also elegantly upholstered. The wheels are fitted with solid rubber tires and the rear ones are 42 inches in diameter, and are propelled by 2-kilowatt electric motors, one for each wheel. The total weight of the vehicle is about 4,200 pounds. Attached to the back in front of the operator is the usual combined voltmeter and ammeter. It is intended to travel at a speed of ten miles an hour, and one charge of the battery will carry it 25 miles on a level macadam road. The Riker Electric Vehicle Company, recently organized for the further development of this and other styles of motor vehicles, has installed a new and extensive plant at Elizabethport, New Jersey, equipped to make every part of a vehicle.



AN ELECTRIC DEMI-COACH.

A NOVEL MATCHER-HEAD FOR PLANING MILLS.

A patent has been granted to Charles R. Harvin, of Parksville, S. C., for a matcher-head, by means of which the cutters or bits can be vertically adjusted to adapt the device to different widths of tongues or grooves. Fig. 1 is a top view of the head with one of the cutters or bits removed. Fig. 2 is a section taken through two adjacent cutters. Fig. 3 is an inner face view of one of the cutters or bits. Fig. 4 is a bottom plan view showing an adjusting mechanism employed.



A MATCHER-HEAD ROTATIVELY AND VERTICALLY ADJUSTABLE.

It is not customary to adjust the bottom cutters or bits vertically; but the upper cutters are, however, thus adjusted to adapt the matcher-head to different thicknesses of floor-boarding or to different widths of tongues or grooves. The means for adjusting the upper cutters or bits will, therefore, be first described.

Each upper cutter or bit has a depression in its inner face, at one side of which depression is a tooth adapted to engage one of a series of notches in the upper end of an exteriorly-threaded sleeve. A bolt passes through the cutter or bit and has a portion angular in cross-section passing through a correspondingly-shaped opening in the sleeve. A washer engages the outer end of the angular portion of the bolt and is provided with notches in its periphery to receive a lug on the under side of the cutter-head. A clamping-nut on the bolt holds the parts in place. In adjusting one of these upper cutters, the clamping-nut is loosened sufficiently to allow the washer to drop clear of the log. The washer can then be turned by a suitable tool, its movement being communicated to the bolt, to raise or lower the threaded sleeve. After being vertically adjusted, the cutter is raised to disengage its tooth from the notches in the upper end of the sleeve. The cutter-head may then be rotated to bring its cutter portion outside of the cutter-head, as shown in Fig. 1. When in this position the cutter is lowered to engage its tooth in a notch; the washer is moved to engage the lug, before mentioned, in one of its notches; and the device is tightened by screwing up the clamping-nut.

The bottom cutters or bits also have each a tooth on their inner faces, which is adapted to engage one of a series of notches in a boss on the under side of the cutter-head, so as to hold the head as rotatively adjusted. The bottom bit is clamped by a bolt and nut.

The Comparative Dietetic Value of White and Wholemeal Bread.

It is commonly supposed that wholemeal bread is more nourishing than ordinary white bread because it contains a higher proportion of nitrogenous and mineral substances. But as we have frequently pointed out, says The Lancet, the nitrogenous value of a given food is not necessarily indicated by an empirical chemical analysis. Not all nitrogenous substances are feeding stuffs, and further, it does not follow that the quantity of food partaken of is the quantity of food assimilated. In other words, eating is not necessarily feeding. There are many substances containing a very high proportion of nitrogen which are valueless as food stuffs, and on the contrary there are many edible materials which contain a comparatively small proportion of nitrogenous substances which, however, are completely available for nourishing the organism. We now know that it is not enough for chemical analysis to record merely the proportion of nitrogenous substances; the nature of these substances must be declared, without which the food value of a given substance cannot be estimated. It was formerly assumed that wholemeal bread contained more nitrogen than white bread, but in the light of recent analyses this is not true. Whether or not, however, wholemeal bread is superior as regards its nitrogenous contents, it is certainly inferior as regards its digestibility. This may be attributed in a large measure to the fact that wholemeal bread contains comparatively large, indigestible, and irritating particles of husk. There seems, however, no reason for doubting that wholemeal bread would be much more digestible if the branny particles were finely comminuted. In several patent breads the germ of the wheat is retained, which adds considerably to the nitrogenous value of the bread. But the germ of wheat tends to excite fermentative changes in the "sponge" and produce an unpalatable loaf. Several processes, however, have been devised which avert the possibility of this undesirable effect. We do not believe that with the improvements in machinery generally the dietetic value of bread has pari passu increased. We still hold that a more nourishing article, as it is certainly more palatable, is the old-fashioned farmhouse loaf, which presents a gold wheaten color rather than the blanched appearance which seems to be looked upon as a guarantee of quality in the modern white loaf. Our own laboratory experience, at any rate, shows that probably on account of the increased employment of roller milling processes the important mineral constituents of white bread have very materially diminished. When it is considered that these constituents play a not unimportant part in supplying the bone-forming factors of the organism, this fact assumes a serious importance and may even throw light upon the prevalence of dental decay. On the other hand, wholemeal bread and germ bread contain an enhanced proportion of mineral salts, such as the phosphates of lime and potash, which are necessary in the building up of the entire human frame.

THREE thousand five hundred and three vessels of all kinds passed through the Suez Canal last year, and of this number 2,295 carried the British flag. The receipts for 1898 were larger than in any previous year since the opening of the canal.

DITCHING ACROSS THE GREAT DIVIDES IN THE ROCKY MOUNTAINS.

BY H. A. CRAFTS.

The Water Supply and Storage Company, of Fort Collins, Colo., upon the completion of the Larimer County ditch, found its water supply to be deficient. The ditch was taken from the north side of the Cache la Poudre River, near the foot-hills of the Rocky Mountain range, and leads through the eastern part of Larimer County and into Weld County. Its length is about seventy miles. It is thirty feet wide at the top and twenty feet wide at the bottom, and it has a carrying capacity of 660 cubic feet of water per second. Under it there are some 20,000 acres of land susceptible of irrigation. Owing to the amount of water taken from the Cache la Poudre by prior appropriations, there was not enough left to enable the company to carry out its original designs. Storage reservoirs in connection with the ditch were constructed on the plains, having a capacity of six hundred million cubic feet of water. These were filled at such times as there was water to spare from the river, but even with the water thus held in reserve there was not enough to supply the deficiency. It needed not only an additional supply for the ditch during the irrigating season, but for the proper filling of the storage reservoirs.

To secure more water from the Cache la Poudre River was out of the question, nor were there other streams having still unappropriated water at convenient distances and tending in the same direction.

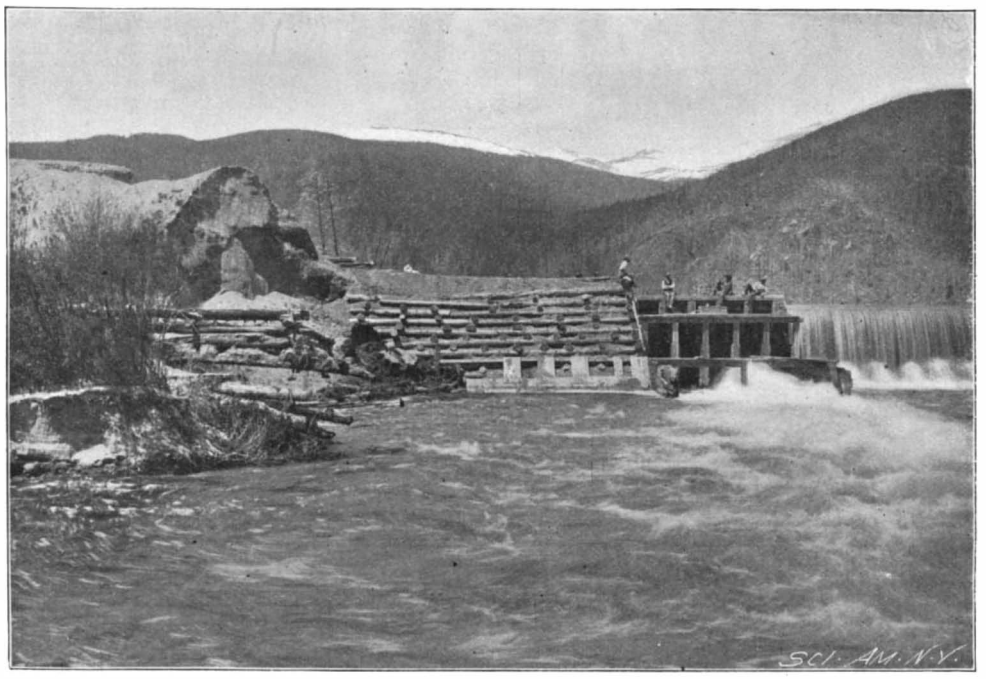
At the head of the Cache la Poudre in the higher altitudes of the Rocky Mountains and some sixty miles above the headgates of the Larimer County ditch was Chamber's Lake. This had been formed by a deep depression, and covered at low water 135 acres, and at high water 212 acres. The ditch company incorporated Chamber's Lake as a storage reservoir, and constructed across its outlet an immense earthwork dam, which raised the lake and gave the company one hundred and thirty million cubic feet of water to draw upon as they found it necessary. But one day, when the reservoir was full, there came a cloudburst above it, and the rush of water into it, coupled with a supposed weakness of the dam at the wasteway, burst the dam, and an immense body of water was let loose and poured down the cañon and into the valley below, causing great damage and entailing much vexatious litigation. The loss was so great that the company was slow to reconstruct its dam, and other sources of water supply were sought.

INTERSECTION OF BIG LARAMIE DITCH AND TWO-AND-A-HALF MILE CREEK.

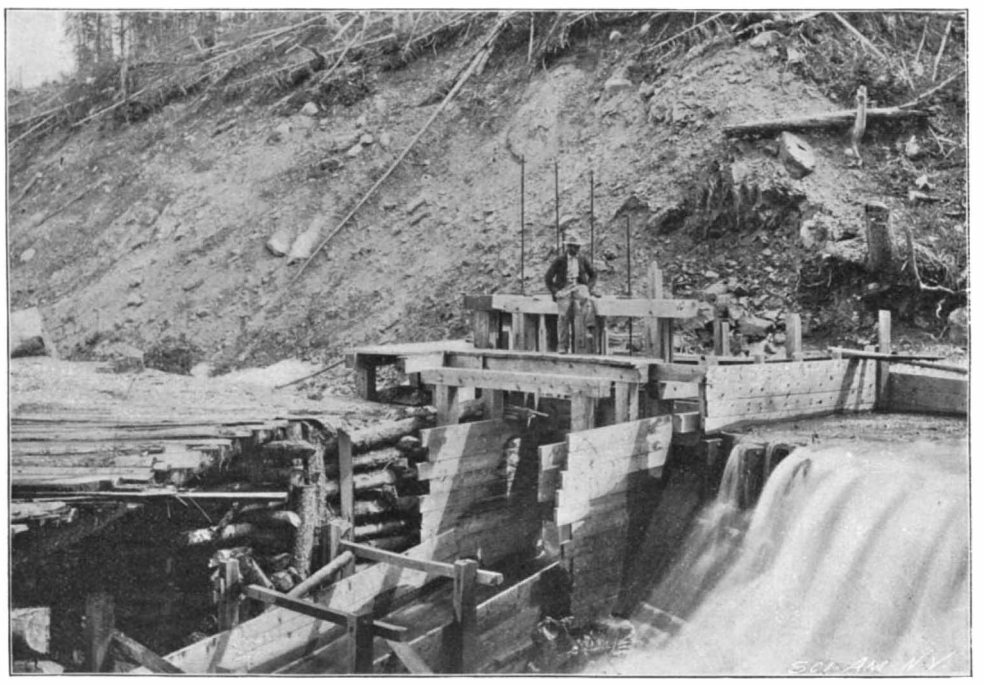
In the vicinity of Chamber's Lake are the head waters of several other mountain streams. Northward some five miles on the northern slope of Mount Cameron are the headwaters of the Big Laramie River, which flows northward and empties into the North Platte River in Wyoming. Westward about the same distance is Cameron Pass, where Michigan Creek and several other small streams have their rise and flow westward down into North Park and empty at last into the North Platte itself. Again, to the southwestward and lying beyond the continental divide are the headwaters of the Grand River, which flows southwesterly and empties into the Colorado River, which in turn flows to the Pacific. Yet the engineers upon investigation found that by tapping these streams at an elevation of some 10,000 feet above sea level, water could be conveyed over the intervening divides and delivered into the headwaters of the Cache la Poudre, and that the water could be legally appropriated, as the streams named yet held large quantities that had not been appropriated for irrigation purposes. The company thereupon decided to obtain a portion of this water by bringing it over the divides to the Cache la Poudre watershed.

They began by tapping the Big Laramie. They commenced their ditch, which was to act as a feeder, high up in a gulch on the northern slope of Mount Cameron, where the river had a discharge of some 500 cubic feet of water, and swung it round to the eastern flank of the mountain to Chamber's Lake, a distance of some five miles, where it discharges into the lake. It was a difficult piece of engineering, located as the ditch was at such a great altitude, and upon the side of a mountain whose slope was at an angle of about 45°. There were three principal classes of material encountered in the excavation—loose earth, loose rock, and solid rock. One tunnel 110 feet in length through solid rock was constructed. The difficulties of construction may be readily imagined when it is stated that the ditch was constructed at least 1,500 feet above the base of the mountain. In the first place, the timber was all cleared from the side of the proposed ditch and then about a foot of vegetable mould was scraped off down to solid ground, and banked on the lower side. With the felled timber, log curbing was constructed to hold the lower bank. Where there was standing timber on the lower side, the felled timber was rolled down against it thus forming another scheme of retention. At intervals for at least two-thirds of the distance around the flank of the mountain small streams were intersected. These were turned into the ditch to add their waters to the general supply. The principal of these streams was Two and-a-half Mile Creek, the intersection of which with the ditch is shown in one of our illustrations. The ditch was at first flumed across the gulch, and then the water from the creek was carried into it over a latticed apron. The apron was designed to both break the force of the water, for the better protection of the flume, and also to permit all floatage to be carried over the flume and discharged into the creek below. Our view was taken on June 25, 1899, and shows the snow banks up the gulch; the bank of the ditch on the left joining the flume in the center; the bridge across the gulch lying parallel to the flume, the automatic wasteway and the surplus water pouring over the apron. The flume is just back of the bridge and extends around to the right.

The ditch is five miles in length; eight feet wide at the bottom and twelve feet wide at the top, and will carry water to the depth of four feet. Its carrying capacity at its head is 240 cubic feet per second; but in order to embrace the water of the intersecting creeks its capacity is gradually increased until at its outlet it has a carrying capacity of 400 feet. The ditch has stood the test well. The lower bank has settled down very solidly and has not yet experienced a single break. The upper bank, however, is subject to a constant sliding process from above. Some parts of the mountain side are springy, and from these, earth slides result. It was also found that the swaying of the trees on the upper bank caused a loosening of the soil so the standing timber was felled some twenty-five or thirty feet further back from the bank. To prevent breakage from sudden floods caused by cloudbursts above, automatic wasteways have been constructed. Log cribbing has also been built upon the upper bank and along the most exposed parts in order to catch loose matter that may slide down from above.



THE CHAMBERS LAKE DAM.



BRIDGE, WATERWAY, AND FLUME AT TWO-AND-A-HALF MILE CREEK.

The company has also reconstructed its Chamber's Lake dam, but in a more substantial manner than formerly. That part of the old earth dam which was carried out has been replaced by a strong dam of piling. The round piling was driven to depths varying from 23 to 25 feet, and the sheet piling from 10 to 14 feet. The dam is 11 feet high above the main floor, 190 feet long on top and 150 feet at the bottom. The dam is built into the old embankment, which is 63 feet wide at the base and 30 feet wide on top, and is faced with crib-work. The new dam and a part of the old are shown in one of our illustrations. The end of the old embankment may be seen at the left. The new dam may be seen in the center, and at the right

the water may be seen flowing over the outlet. The outlet consists of five gates, each 2 feet 8 inches by 4 feet, making 53⅓ square feet. The gates are operated by screw power. The up-stream front of the gates has an apron 16 feet wide with a drop of 3 feet well packed in gravel. On top, and level with the main floor of the dam, is a second floor, and also sides reaching nearly to the top of the dam to prevent the gravel filling on the apron and in front of the main dam being carried away by the current. Below the gates a flume 32 feet long was built in order to carry away the water from the main dam and prevent washing and undermining. The dam will carry 10 feet of water, and the amount of water that can be held in store is 55,000,000 cubic feet.

Sound Reflection and Refraction.

BY REV. JOHN M. BACON, M.A., F.R.A.S.

More than one recent disaster at sea, still unexplained, has pointed to the necessity of reconsidering certain accepted dogmas relating to the transmission of sound waves, and official reports of a disquieting nature from look-out stations have called once and again for serious investigation of the anomalous behavior under special conditions of such sound signals as are commonly in use at sea. In particular it has been insisted on that the hearing of the siren and fog-horn is apt to prove uncertain and that, on occasions at least, there are to be found areas or zones of silence where their warning will unaccountably fade or else cease altogether to be heard.

It would appear, however, that this peculiarity is not by any means confined to the signals of those instruments of which the siren is the type. The writer has had special opportunities of experimenting with explosive signals of many kinds, and has on three separate occasions, and under very different circumstances, carried out systematic trials on the penetration of the service cotton-powder cartridge fired at different heights from balloons while traveling over diversified open country as also over populated districts including London itself. These trials have drawn records from a large number of independent observers, whose statements, when carefully analyzed and compared, have proved beyond all reasonable doubt that even the most powerful and deservedly well trusted form of modern explosive signal is sometimes fickle in its character, failing or fading in unexpected quarters without obvious cause.

It will probably be readily conceded that the explanation of these facts must be sought not so much in any peculiarities in the sounds themselves as in the condition of the medium through which they are propagated, and it is here that the views expressed perhaps too confidently a generation ago may need to be modified. Certain conclusions as to states of atmosphere commonly affecting the passage of sound waves have perhaps remained too long unchallenged.

Thus Prof. Tyndall states that while conducting experiments with sound signals at the South Foreland there were present always and in all weathers invisible acoustic clouds which returned echoes from the instruments and cannon planted on the summit of the cliff overhead. Hundreds of cannon-shots, he states, were fired, and were always followed immediately by a rumbling which the Professor asserted must have come only from out of the empty air. If this were so, then we must conceive that there was constantly present in the air some form of obstruction that not only impeded but reflected back the waves of sound that were being emitted.

It is with regard to this point that some results recently obtained may be deemed instructive. In the first place, although during the experiments in which I have been concerned some scores of cotton-powder signals have been fired from balloons under very different meteorological conditions, nothing of the nature of an aerial echo has ever been suspected, and the dead silence aloft has always been absolutely unbroken after each report until, after an interval of several seconds, the earth itself has replied with a burst of sound which has reached the ear even at the height of a mile with all the intensity and reverberation of a thunder-clap. This striking result, invariably the same, appears highly significant, and would point to the conclusion that the initial report immediately consequent on a lightning flash is, like the fog-signal bursting below the car, comparatively speaking only a trivial sound, while the great uproar of sound must practically be wholly due to echo, which is presumably largely off the ground. In support of this I would state that when one of the signal cartridges already described is fired, say, 150 feet above the ground, in moderately open country, an observer below hears a series of extremely powerful echoes which he can easily trace to each clump of trees or building around, and several seconds after this elapse before the subsequent conflict of reverberations ceases. Further, when such a rocket signal has been fired over a wide extent of quiet common terminating at some distance in an abrupt decline, it has awoke surprising and unexpected echoes from woods lying in the valley, although these have been completely out of sight and sheltered from the ear by a considerable stretch of intervening level ground. In this case both the incident and reflected waves of sound had clearly been defracted or bent over the shoulder of the hill which hid the woods from view.

I would then submit, first, that a condition of atmosphere causing aerial echoes is by no means the normal condition, and, secondly, that the return of sound which Prof. Tyndall, when stationed under the cliff, appeared to hear almost instantly from the offing may in actual fact have been defracted from cliffs and headlands hard by but out of sight.

That aerial echoes are sometimes heard I would, as the result of my own experiences, very readily admit, and I would regard the condition of atmosphere favoring this phenomenon as one probable cause of that failure of sound at certain spots which has been already referred to.

But some other dogmatic statements which have already done service full long respecting the reflection of sound waves may well be questioned. Take the well-known example attributed to the Whispering Gallery of St. Paul's. Here as I have pointed out elsewhere the transmission of a whisper around the circular wall is obviously not due to reflection in the ordinary sense, as any one may convince himself by testing the phenomenon in quiet night hours. Or, again, if on a calm day a smooth crescent-shaped surface similar to a segment of the Whispering Gallery be constructed in the open—as may be readily done by means, say, of a length of continuous stout brown paper stretched on battens—an experimenter will find that the Whispering Gallery effect can be produced under circumstances where reflection from an opposite surface is impossible. A whisper communicated either by the mouth or suitable instrument against such a curved surface appears to course round in close contact with the surface.

I would note that the description given by Sir John Herschel of the peculiar phenomenon of the Whispering Gallery, which has been copied and re-copied into every text book, is obviously incorrect, and so also, as I am prepared with due permission to point out, is that relating to the echoes at Woodstock. From which I would gather that neither Herschel nor those who have quoted his words have ever investigated the phenomena in question.

In connection with echoes a very noteworthy result has presented itself in the course of the acoustic ballooning experiments in which I have been engaged—namely, that the echo from earth of exploding signals has been always and uniformly retarded. This result has been obtained and verified very many times by independent observers using carefully corrected instruments, and no doubt has been entertained of its truth. Whether, however, this retardation be due to a diminution in the rate of sound traveling vertically through the atmosphere or to any "dwell" or "lag" in the actual reflection of sound I am not at present prepared to state.

As suggesting a further cause possibly operative in the occasional local failure of sound signals, I would call in evidence certain experiences of my own with regard to the effect on sound of fog or cloud. Prof. Tyndall insists that fog has no sensible power to obstruct sound, while air associated with fog being, as a general rule, highly homogeneous is favorable to the transmission of sound.

I am able to assert that this view is very far from being generally accepted by practical men employed on look-out stations, and it is entirely opposed to the statements of Stevenson and other eminent authorities. My own observations gathered in balloon voyages, and also during a sojourn of several days and nights, generously granted me by Trinity House, on the Maplin Lighthouse in thick weather, go to show that whereas a condition of still and settled fog may aid the travel of sound, compacted cloud-heaps or wreaths and masses of rolling mist are capable of refracting and diverting sound waves in a manner that will deceive the most practiced ears. For example, the warning of neighboring light-ships' fog horns as heard from the Maplin are influenced in a far greater measure by the circumstances and qualities of intervening fog than by a gentle wind; moreover, a horn which had been nearly quenched by interposing mist has been observed to sound with far more than normal intensity as soon as the fog had rolled away behind, forming a background to gather and reflect the sound wave.

I would call attention to the fact that many accepted statements that have done duty in the past with regard to the travel of sound waves seem to have been based on the results of experiments conducted in the laboratory, and I would submit that a more unfavorable place for satisfactory experiments on sound could hardly be chosen, inasmuch as the six bounding surfaces must surely cause reflection seriously endangering the truth of results obtained. Conducting experiments of this kind must often rather resemble such a feat as trying to project lantern pictures in a room where walls, floor, and ceiling are all faced with brilliant mirrors.—Knowledge.

Automobile News.

The automobile never ceases to be an attraction at the modern country fair, and several persons make their living by making the circuit of the country fairs.

The Chiswick (London) Vestry has used motor vehicles for the removal of ashes, etc., for about two years, according to The Motor-Car Journal, with great satisfaction.

A motor fire engine has been constructed by an English firm of fire engine builders. Engines of this kind have been in use in the United States for some time and have been successful.

Baron von Aanachetto has crossed the Alps between Switzerland and Italy by way of the Brenner Pass. The road was excellent and was largely used by vehicles drawn by horses until the Brenner Railway was opened.

A Philadelphia paper is trying to organize a race for motor-vehicles to take place on Broad Street, the longest asphalted street in the world. Competitions of this kind are most unfortunate for the industry, and their value is very slight.

An international congress of automobiles to be held in Paris during the Exposition is under consideration. There is little question that such a congress would be educational to the drivers of the vehicles themselves and of great benefit to the new industry.

There is one automobile paper in Austria, two in Belgium, and in France there are twelve, including two dailies, seven weeklies, one bi-weekly and two monthlies. There are two in Germany, three in Great Britain, and in this country we have seven or eight.

An automobile exchange and training school has been opened in West Fifty-eighth Street, New York city. Here vehicles propelled by different motive powers will be kept in service and competent teachers and repairers will be ready to instruct the novice and to repair vehicles. A course of five or ten lessons in the management of automobiles will be given.

The Automobile Magazine has at last come to hand and is the most thoroughly satisfactory periodical which we have seen in any language on the subject. It is of regular magazine size and has 111 pages. The quality of the articles is very high and the illustrations are of the best. Everyone who is at all interested in the automobile will find something in the new magazine which will interest him. Even the social side is far from being neglected, as there is an article on the recent floral parade at Newport and on the Automobile Club of France. The Automobile Index, which occupies some nine pages, is exactly what has been needed. On the whole the magazine is a most satisfactory one.

Manufacture of Artificial Sponges.

The process patented by Dr. Gustav Pum, of Graz, Germany, consists principally in the action of zinc chloride solution or pure cellulose. The results are amyloid and hydrocellulose-like products, which swell up with water, but turn horny and hard on drying. In order to retain for the product the property of also absorbing water after drying, alkali-haloids are employed in treating the cellulose with zinc chloride, and finally the product is subjected to a mechanico-plastic treatment. Thus, for example, 2,000 grammes of concentrated zinc chloride solution and 2,000 grammes of sodium chloride are used for 100 grammes of cellulose, whereby a pasty viscous mass is obtained which is mixed with about 1 kilo of coarse grained rock salt. The plastic mass thus obtained is pierced in a press mould with pins, after whose removal the pressed material appears traversed by small canals in all directions. The excess of salts is removed by washing one or two days with alcohol and water. The product thus obtained can take the place of natural sponges in all its uses, and may especially serve for filtering water for sanitary and industrial purposes. It is also suitable for filling up life preservers, for the production of anchor buoys, as well as in surgery for absorbing secretions, etc.—Chemische Revue über die Fett- und Harz-Industrie.

Fires in the United States.

The Chronicle Fire Tables which are published annually by the organ of fire underwriters give some curious details regarding the fire losses in the United States during the past year. They show that the average loss by fire has been reduced in ten years from $6,922 in 1888 to $1,860 in 1898. The insurance loss in the same period was reduced from $3,993 to $1,056. The extended use of electricity has brought about a large increase in the way of fires due to electric wires and lights. Ten years ago there were only sixty-six such fires, but in 1898 there were no less than 958. Defective flues are responsible for 11·23 per cent of the fires. Incendiarism is accredited as the next largest cause of conflagrations. No less than 6,891 incendiary fires are shown to have occurred in 1898. 3,479 fires were caused by lightning; 1,179 by spontaneous combustion; 295 by friction in machinery; 94 by natural gas; 14 by dust explosions, and 5 by the sun's rays passing through window glass. 12,204 fires had no assignable cause.

Science Notes.

There are twenty carbide manufactories in France, most of them obtaining their current by means of water power.

The British Association for the Advancement of Science has granted a thousand pounds sterling toward the expenses of an Antarctic expedition.

Prof. Kreutz, at Kiel University, has telegraphed the Harvard College Observatory, on October 1, that a comet was discovered by Gacobini at Nice, on September 29.

The work of equipping the elevated railroad of Brooklyn with the third-rail system of motive power is progressing rapidly. The Fifth Avenue line is already being operated by electricity.

One of the laundry trade journals recently noticed a new antiseptic which is intended to sterilize clothes when being laundered, thereby preventing contagion. A formaldehyde solution is solidified, and this is used by laundrymen.

United States Minister Merry at San José, Costa Rica, has informed the State Department that the government of the country has issued a decree establishing international copyright between Costa Rica and the United States.

The Nathorst expedition, which has been searching along the coast of Greenland for Andrée, arrived September 12 at Malmo, Sweden. No trace of the aeronaut was found, but a new series of inlets were discovered and valuable ethnographic material was obtained.

The London poor suffer terribly from overcrowding. According to The Sanitary Record, 15,150 persons lived in 4057 tenements with one room in the parish of St. Mary's, Newington; 40,184 persons in 7,670 two-roomed tenements; and 13,742 persons in 1,752 three-roomed tenements.

According to The Engineer, an American firm is turning out a large quantity of paper tiles for roofing purposes. They are said to be hard and tough, and the glazing somewhat resembles Japanese lacquer. They are said to be cheap, and can be made in any color or shape to suit the purpose.

The number of women in attendance at the German universities during the summer semester of 1899 was 355. There were 179 at Berlin, 45 at Bonn, 27 at Breslau, 29 at Göttingen, 13 at Heidelberg, and 19 at Halle. The University of Strasburg has just decided to admit women to its courses. Hitherto it has closed its doors to women, but now there is no German university where they may not pursue their studies.

In The Physical Review, Prof. E. L. Nichols states that he had utilized a spell of exceptionally cold weather at Ithaca to make experiments in thermal expansion. These were made on bars of artificial ice 45 cm. long, and the open-air temperature fluctuated between —3° and —17°. The marks observed in the microscopes were the rims of small drops of mercury lying in hollow cavities in the ice. The coefficient obtained was 54×10^{-6}, which agrees best with Struve's value.

Prof. Knight and his party have returned after visiting the fossil lands of Northern Wyoming. The expedition left on July 21, and returned September 1. In addition to the discovery of a large number of fossils, photographs were taken for the first time, and after great difficulties, of the Upper Platte Canyon and of Bate's Hole. The expedition has proved so successful in every way that the Chicago & Northwestern Railroad is now planning for next season a similar undertaking from the western terminus at Casper, Wyo.

Herr F. Czapek confirms the observations of Miyoshi and Marshall Ward, that the hyphæ of certain fungi have the power, not only of perforating wood, but also of consuming the stores of starch and other food materials in the tissues of the host-plant. In the cases of Pleurotus pulmonarius and Merulius lachrymas, he succeeded in extracting the enzyme by means of which the lignified walls of the cells are destroyed, and proposes for it the term hadromase, in contradistinction to the cytase which consumes the cellulose. — Ber. Deutsch. Bot. Gesell., 1899, 166.

Mr. W. F. Rigby, of Philadelphia, says, regarding the effacement of the records from phonograph cylinders, "Place the cylinders on a mandrel and put it in the lathe or on the mandrel of the phonograph. In this case the motor of the phonograph is not quite of sufficient power to turn out a highly-finished cylinder. If, however, the hand wheel is connected direct to the phonograph, the results are better. Take a smooth rag and moisten it in spirits of turpentine and rub it on the cylinder, keeping it constantly rotating, then rub for a short time with a rag moistened with alcohol. After this dry and polish with a smooth cloth." By the above method a cylinder can be cleaned in about a minute with a finely-polished surface far surpassing any record that has been shaved. Records taken on the cylinders so treated have the grating sound so objectionable in low talking records reduced to a minimum.

Engineering Notes.

On January 1, 1899, the length of the whole Russian railway system opened for traffic was 26,958 miles. This included the lines in Russian Asia.

According to The Engineer, acetylene gas kept in its holder for some days falls off in lighting power and its deterioration is well marked even after twelve hours.

It is expected by the end of the year that a hundred locomotives on the Boston and Maine Railway will be fitted with water grates, so that coke can be used as a fuel.

The Board of Ordnance and Fortification has decided that the utmost care shall be exercised in having tests carried on at the proving grounds so that the character of the projectiles, explosives and guns experimented with, and the results of the tests, will not be made public.

The Eiffel Tower is being painted with five shades of enamel paint. The summit and the dome are to be a chrome yellow. The shades will graduate to the pedestal, which will be of dark orange. Two coats will be required and nearly fifty tons of enamel paint will be consumed.

Delaware Avenue, Philadelphia, Pa., has been widened from about 50 to 152 feet, and a strip 100 feet wide has been reclaimed from the river. The extension of the piers is also being made. It is being done by the Bureau of Surveys of the Department of Public Works, of which George S. Webster, C. E., is chief engineer.

During the Dewey land parade it is estimated that 800,000 people used the Brooklyn Bridge cars; the Sixth and Ninth Avenue Elevated Roads alone carried 490,000 passengers; 240,000 by Pennsylvania Railway and ferries, and 3,000,000 in all saw the parade. Notwithstanding the enormous volume of traffic on all of the roads, the percentage of accidents was trifling.

A manufacturing firm of Hamilton, Ohio, shipped on September 11 the equipment of one of the finest paper mills in the world. It was sent to Yokohama for the Japanese government, and was loaded on twenty-five cars. Japan has decided to make her own paper, as some of her state documents have deteriorated with age. The machine will turn out a 109-inch strip of the finest book paper 400 feet long each minute.

The Hydrographic Office of the Navy Department has published a new chart of the world showing the ocean tracks with distances given in nautical miles. The longest steamer route given on the map is that connecting New York and Esquimault by way of Cape Horn, 16,290 miles. This is exceeded by the track used by sailing vessels connecting New York and Yokohama via the Cape of Good Hope. This is 16,900 miles in length.

The Italian Ministry has ordered 111 locomotives, 458 passenger coaches, 56 luggage vans and 3,050 goods wagons, or freight cars as we term them in this country. The total value of the order is over $8,000,000. According to The Engineer, this increase in the rolling stock is in addition to the 112 locomotives and 1,050 goods wagons which have already been ordered to meet the needs of the Mediterranean and Southern Railway of Italy.

A correspondent, Mr. Nathan Appleton, of Boston, suggests that steamers of the size of the "Oceanic" could not pass through the Nicaragua Canal. According to the report of the Walker Nicaragua Canal Commission it is recommended that locks 665 feet in length be constructed. The length of the "Oceanic" being 704 feet, it would, of course, be impossible for vessels of this size to pass through the canal even if it should be finally built. Mr. Appleton recommends the construction of a tide-level canal at Panama.

An experiment is being tried by the High Wycombe Company of renting gas engines. High Wycombe is devoted almost entirely to chair making, and in this trade a small number of manufacturers are engaged. The locality seems a proper one, say Industries and Iron, in which to develop the renting of engines. A well equipped office has been opened for demonstration purposes, and the company will put in service pipes and fittings free of cost. The gas engines are not only rented, but are also sold on what they term in England the "hire-purchase plan."

Two acetylene gas plants are being installed at two of the shafts of the Washington aqueduct tunnel. The plants are of 60 and 300 burners capacity, respectively. In a report by Lieut.-Col. A. M. Miller, of the Corps of Engineers, United States Army, it is stated that the fumes and smoke from the blasting added to the smoke from torches and lamps rendered the atmosphere very offensive and discomforting to the workmen. Acetylene gas was selected as the most available and economical for the special purpose. The gas pipes are carried down shafts from the plants and run along the tunnel with cocks for burners every 30 feet, and this system suffices for the illumination of the tunnel for a distance of about 2 miles. Movable lights of several burners are connected with rubber hose and used to concentrate the light in the immediate vicinity of the work.

Electrical Notes.

There are 112 towns in France outside of Paris which are provided with telephone exchanges.

Hawaii is said to have more telephones in use in proportion to the population than any other locality in the world.

Telephone rates at the Paris Exposition will be $60 for the installation and service during the period of the exposition.

The power station of Niagara Falls Park and River Railway was destroyed by fire September 4, and much valuable machinery was ruined.

In London the various underground electric systems for rapid transit involve the expenditure of about $100,000,000 for their completion.

Catania, Sicily, will soon have twenty-four miles of electric railways, the municipal authorities having given the concession to German capitalists on terms advantageous to the city.

The automatic coin-controlled telephone is in considerable use in Berlin, and if the results of the experiments are satisfactory, this means of communication will be used all over Germany.

From 1893 to the present year the number of steam boilers in the Transvaal has increased from 1,071 to 2,282; three of the gold fields alone employing no less than 280 dynamos, supplying 1,400 motors and 33,000 lamps.

According to The Electrical World, the plant of the Société Lyonaise de Force Motrice du Rhône has now 504 contracts for power, amounting to 2,465 horse power, and 834 contracts for current for lighting equivalent to over 36,000 incandescent lights.

According to reliable newspaper reports, dispatches from the Continent state that the telephone department of France has received $90,000 for the dispatches which were sent out during the Dreyfus trial at Rennes. Between eight and nine million words were sent out.

The Pike's Peak Power Company proposes to develop 3,200 horse power for distribution for mines in the neighborhood of Cripple Creek, Col. The source of the water supply is Beaver Cañon and a steel and rock dam will be built, having a storage capacity of 150,000,000 cubic feet.

The Kashmir Railway is to be constructed over 186 miles in the most mountainous part of India. It will be operated by electricity, water power being used. This permits of a much lighter motor for drawing the same load, and also permits of grades which a steam engine could not climb without recourse to the rack system.

Many of the Young Men's Christian Associations are giving instructions in electricity to evening classes. Technical instruction for those engaged in the electrical industry is important, and unfortunately they are in too many cases deprived of opportunities for obtaining electrical knowledge beyond that which can be gained in connection with their everyday work.

Dr. E. W. Scripture described before the American Association for the Advancement of Science the method of producing an æsthesia by the direct application of an electrical current without the application of drugs. An alterating current with equal positive and negative phases was made to traverse the nerve. At a proper frequency of about 5,000 complete periods in a second it can be made to cut off all sensatory communication by this nerve. Needles can be run into the part of the body supplied by this nerve without any pain being felt.

An electric fog horn has been invented by a Canadian electrical engineer. A naphtha engine supplies the motor power for a dynamo, which furnishes the electric current by means of which three pairs of electro-magnets operate half a dozen clappers, which strike against a large gong with the frequency of about 36,000 strokes to a minute, producing an almost continuous sound. Its effectiveness is enhanced by a mechanism on the principle of a megaphone, by means of which the sound is not only intensified, but thrown in the required direction. According to The Western Electrician, the sound from a small model was heard a distance of two miles. A full-sized fog horn is to be sent to the British Columbia coast, where it will be installed and put in operation at once.

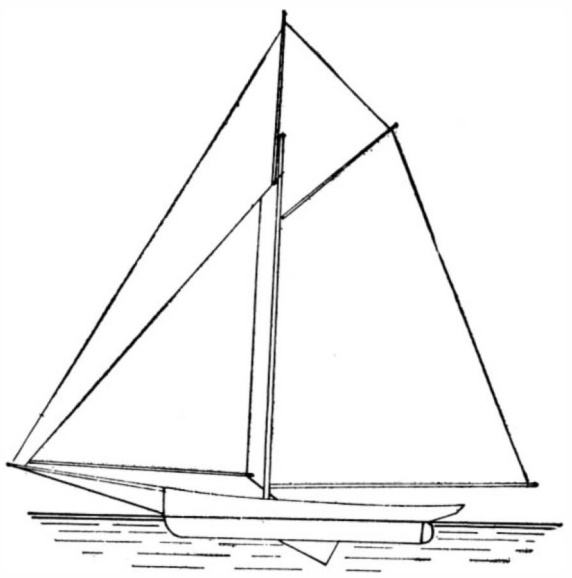
A tunnel between the Post Office and St. Martin's-le-Grand, London, and the London and Northwestern Railway station at Euston, which has lain idle for nearly forty years, is now to come into practical use. It was built in 1859 for the purpose of carrying mails and parcels from the Post Office to the railway station pneumatically. The railway cost $875,000. The difficulties of using pneumatic pressure on a large scale caused the project to end in failure. The power was increased from 100 to 800 horse power, but the results were the same. The tunnel is 4 feet in height and 4½ feet in width. Now an electric train is to be run through it and a regular mail service between the important station and the Post Office can be maintained. The trip will require only about five minutes. The tunnel is also to be lighted electrically.

FIFTY YEARS OF INTERNATIONAL YACHT RACING.

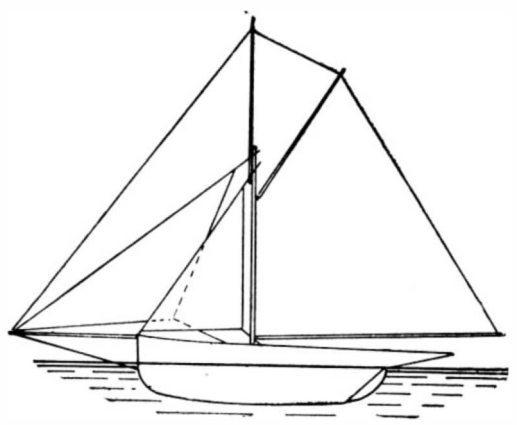
II. SLOOP TO CUTTER-SLOOP.

In the first, or schooner, period of the cup contests, extending from 1851 to 1881, there was no such clearly defined struggle of type against type as was witnessed in the later races of the second period, when the English yachtsmen received some consolation for their successive defeats in knowing that their American competitors, in the struggle to retain the "America" cup, have been forced to abandon the time-honored centerboard and adopt the lead-ballasted keel.

Although the shifting centerboard in the sloop, and the lead-ballasted keel in the cutter, constituted the radical difference between the two types as they existed in the seventies, they were by no means all the difference; for it is a fact that the rig and sail-plan of the two types showed as great variation as their models. This will be evident from a comparison of the two diagrams herewith presented.



SLOOP RIG.



CUTTER RIG.

RIG. — The sloop rig was distinguished by great length of mainmast and a relatively short topmast. The mainsail had a lofty hoist, the gaff was peaked rather low, and the sail was laced to the boom. There was a single headsail, which was also laced at the foot to a boom. The bowsprit was a permanent fixture in the bows and it had a pronounced upward rake. The sloop sail plan may be described as being lofty and narrow. The cutter rig, on the other hand, was relatively low and broad. The mainmast was short and the topmast long. The mainsail had a short hoist, but the long gaff was peaked high, giving a better set to the canvas for windward work. The mainsail was hauled out taut to the end of the boom, but was not laced to the boom as in the sloop. The area forward of the mast was divided between two sails, a jib and foresail, neither of which carried a boom. The bowsprit could be reefed inboard in heavy weather.

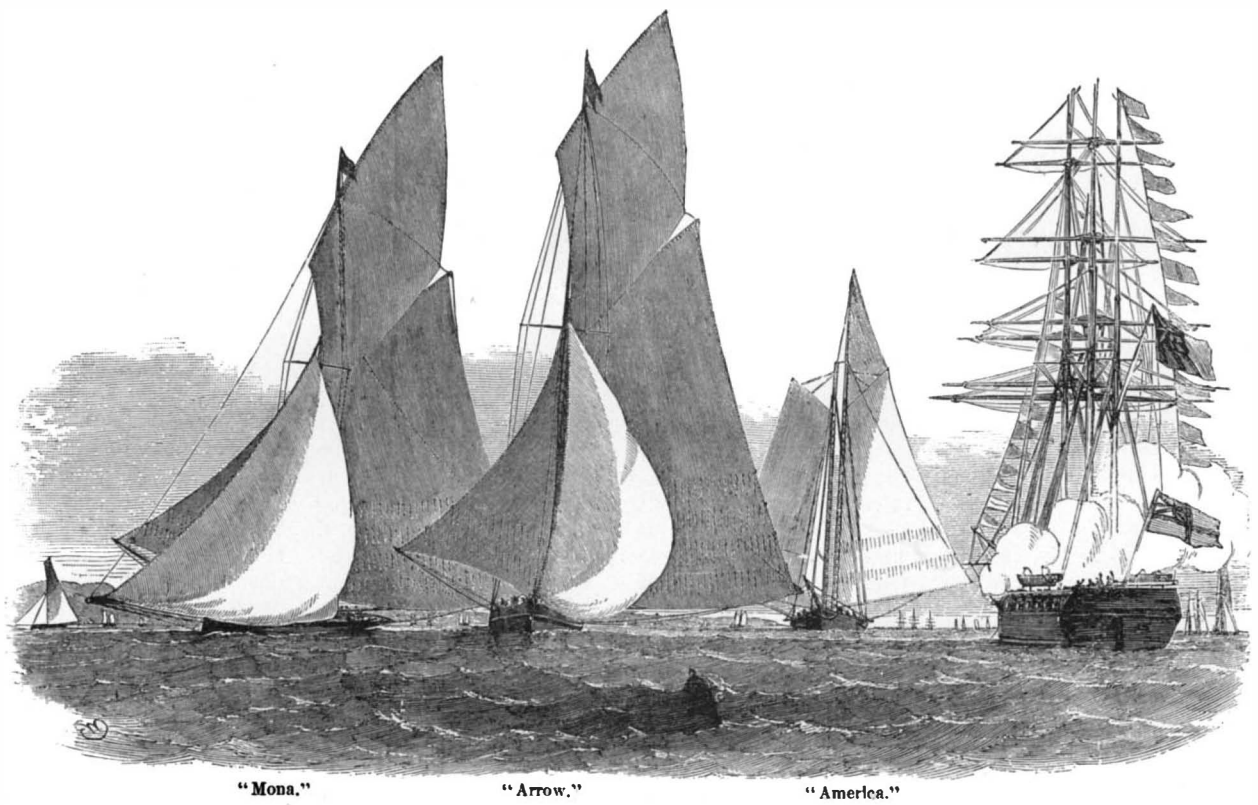
MODEL. — The sloop was distinguished by shoal draught and great beam, as distinguished from the cutter of that day, which, under the influence of the Thames rule of measurement for time allowance, by which a penalty was placed upon beam but none upon draught, had grown to be deep and extremely narrow. This extreme narrowness, it should be said, was purely the result of the Thames rule, for the earlier English cutters were as beamy as the American sloops, as may be seen in the case of the cutter "Arrow," built in 1832, which on a length of 61 feet 9½ inches had a beam of 18½ feet, and in the "Mosquito," built in 1848, which, with a waterline length of 59 feet 2 inches, had a beam of 15 feet 3 inches. The Thames rule, adopted by the Yacht Racing Association in 1879, produced a "plank on edge" type of cutter, and the ratio of beam to length decreased until in the "Tara" the beam was only one-sixth the length. The Thames rule continued in force until after the "Genesta" and "Galatea" had raced for the "America" cup. As soon as it was replaced by a rule in which the penalty on beam was removed, we see a return to the more reasonable proportion of an earlier day, the "Thistle" (see accompanying diagram) having a beam of 20 feet on a waterline length of 86½ feet.

The sloop depended for its stability upon breadth of beam, the cutter upon outside lead ballast, bolted to the bottom of the keel. The sloop had great initial stability; but after she passed a certain angle of heel, the margin of stability rapidly decreased, until a vanishing point was reached, beyond which capsize was inevitable. The keel cutter had small initial stability, but as she heeled the righting moment of the lead keel increased, until it was at a maximum, when she experienced a "knock-down." The displacement of the sloop was relatively small, that of the cutter relatively large. The sloop, by virtue of her initial stability, could carry an excessive sail spread, that of the cutter was relatively small. The one was an ideal light-weather boat, the other was at her best in a strong blow.

FIFTH CHALLENGE—"GENESTA."

Early in the year 1885, a challenge for the "America's" cup was sent to the New York Yacht Club through the Royal Yacht Squadron by Sir Richard Sutton, the owner of the crack keel cutter "Genesta," which had defeated with comparative ease the fleetest craft of her kind in British waters. It was quickly recognized that there was no sloop afloat in American waters that could hope successfully to meet the challenger, and hence two sloops, the "Priscilla" and the "Puritan," which embraced the latest improvements in this type of vessel, were constructed; and after a series of competitive races the "Puritan" was selected to defend the cup. The "Genesta" was a typical "Thames measurement" deep keel cutter, 81 feet on the water line, 15 feet beam, and 13 feet 6 inches draught. The "Puritan" was a marked departure from the national type, of which she retained only the characteristic features of great beam, shallow hull, and centerboard. She carried the cutter rig practically in its entirety and also the cutter outside lead, 32 tons of this useful metal being bolted to the bottom of her keel. With a displacement smaller than that of the "Genesta" by 36 tons, she carried a slightly larger sail spread.

In the first race the "Puritan" fouled the "Genesta" in the attempt to cross her bow when the latter boat had the right of way. The "Puritan" was ruled out on the spot and the race given to the "Genesta" with the privilege of sail over, but Sir Richard Sutton, with characteristic sportsmanship, refused the privilege and set a precedent which may well govern all such unfortunate contingencies in future races. The first race ultimately came off on September 14, 1885, in a light and fluky wind, and the shallow, light displacement boat won easily by 16 minutes and 19 seconds. The second race resulted in one of the most exciting and memorable contests in the history of the struggle for the cup. The course was twenty miles to leeward and return, and the "Genesta" rounded the outer mark fully an eighth of a mile ahead. On the twenty mile close-hauled thrash to the home mark, the wind freshened and offered a splendid opportunity to test the windward qualities of the two types of vessel. The "Puritan," seeing the probability of an increase in the weight of the wind, took in her topsail and housed her topmast; but the cutter clinging to her topsail and heeling down to the wind until the 70 tons of lead in her keel could get in its steadying effect, began to make a splendid exhibition of cutter work in the favorable cutter weather. The "Puritan" under her snugger canvas, and with the incomparable centerboard to edge her up into the wind, began steadily to overhaul her rival, and sailing up into the weather berth, she came romping home the winner of a magnificent race by the close margin of 1 minute and 38 seconds.



AMERICA COMPETING AGAINST THE ENGLISH CUTTERS.
(Reproduced from an old print.)

SIXTH CHALLENGE—"GALATEA."

The following year witnessed races between the cutter "Galatea," owned by Lieut. Henn, and the centerboard sloop "Mayflower," which, like the "Puritan," was owned by General Payne, of Boston. After the defeat of the "Genesta" by the "Puritan," but little apprehension was entertained regarding the visit of the "Galatea," as she was known to be an inferior vessel to her predecessor. The victory of the "Mayflower" over the "Galatea" was complete, the centerboard sloop beating the keel cutter by 12 minutes and 2 seconds in the first race and in the second race by 29 minutes and 9 seconds.

SEVENTH CHALLENGE—"THISTLE."

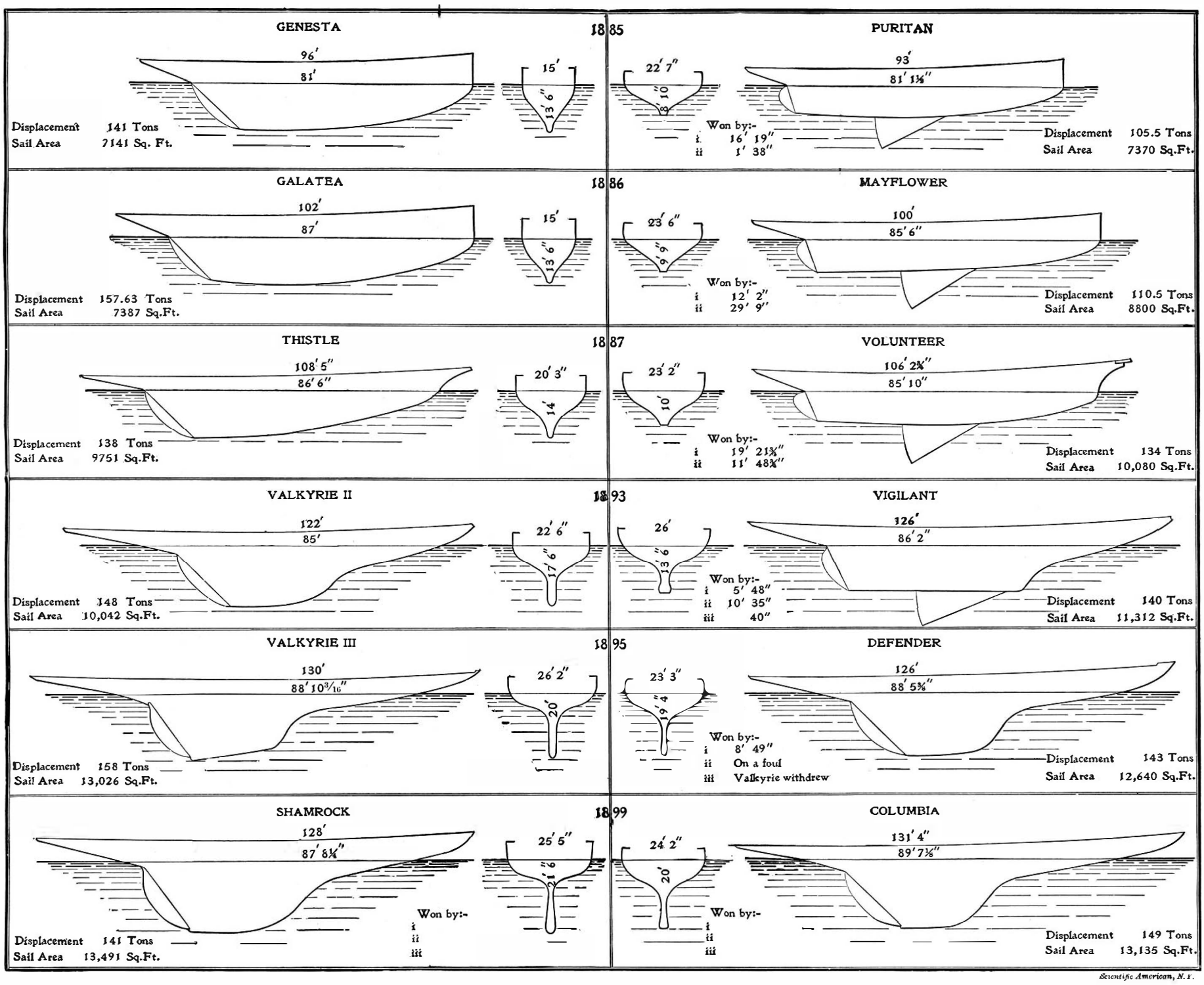
The impossibility of winning the "America" cup with a yacht built under the restrictions of the Thames rule of measurement led to the adoption of a new rating rule, based on water length and sail area, which resulted in a return to the broader beam that characterized the earlier English cutters of the "Mischief" and "Arrow" type. The effect was noticeable in the next challenger, the Scottish yacht "Thistle," which with 5 feet more beam than the "Galatea," and about 20 tons less displacement, carried 2,400 square feet more sail. The "Thistle" came to America in 1887, with a record of being by far the fastest cutter in British waters, and the supreme confidence of the syndicate of Clyde yachtsmen who owned her was only equaled by the dismay which the record of her victories carried to the hearts of many American yachtsmen. The eyes of the yachting world turned instinctively to General Payne, and the brilliant designer of "Puritan" and "Mayflower," Mr. Burgess, of Boston. Results proved that their confidence was not misplaced. The "Volunteer," as the new craft was named, showed a further development along the lines upon which Mr. Burgess had worked in the "Puritan" and "Mayflower." The draught had increased to 10 feet, and the outside lead, or rather, in this case, the lead that was run into the deep, hollow keel, amounted to 50 tons. The sail plan of the "Volunteer" was by far the largest ever spread on a "single sticker," and in the preparatory trial races she had no difficulty in vanquishing the two preceding cup defenders.

In the days of the "Thistle" and "Volunteer" contest there was the same anxiety as to the fate of the cup which is noticeable in the present "Shamrock" and "Columbia" contest. In the very first race, however, sailed in a light breeze, the "Volunteer" came home with a margin of 19 minutes and 21¾ seconds to her credit. Then, as now, the challenger was reputed to be a perfect glutton for heavy weather, and the

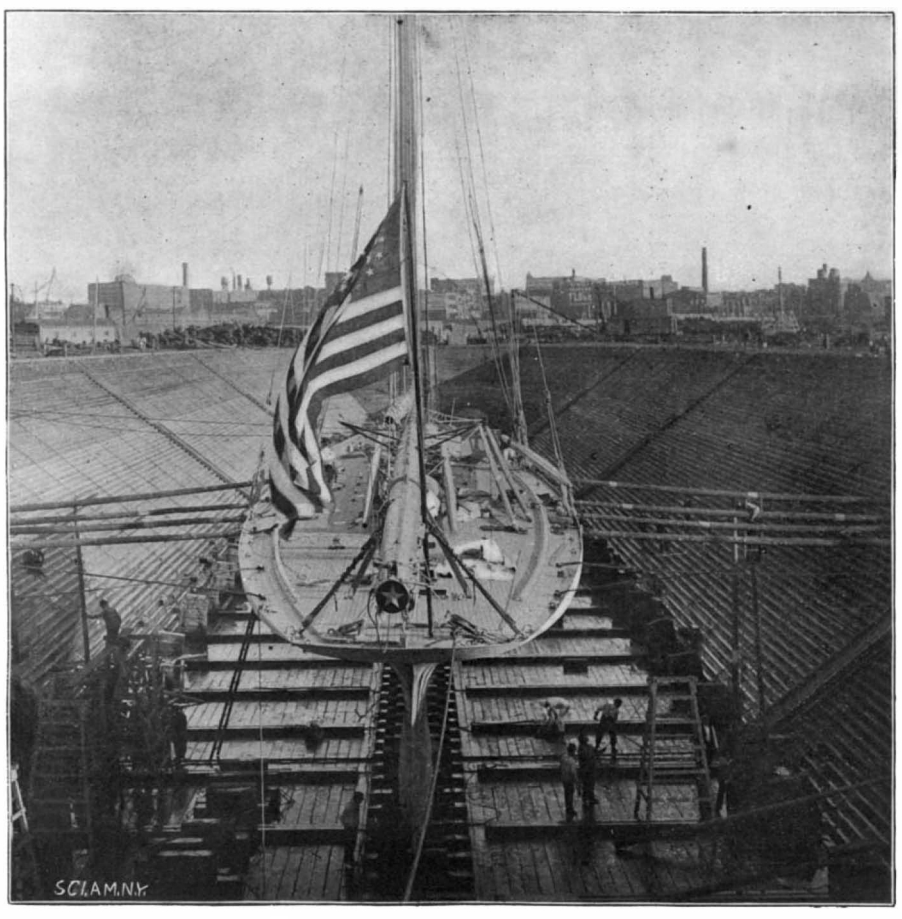
"Thistle" contingent prayed for the strong wind which was necessary to drive the Scottish champion to victory. It came in the second race, which was held over the outside course; and in a thrash of fifteen miles to windward and return it was found that the "Volunteer" liked a piping breeze just a little better than the "Thistle." She lay so much closer to the wind and footed so much faster than the cutter as to turn the outer mark 14 minutes ahead. She lost somewhat on the run home, but finished in the lead by 11 minutes and 48¾ seconds.

EIGHTH CHALLENGE—"VALKYRIE II."

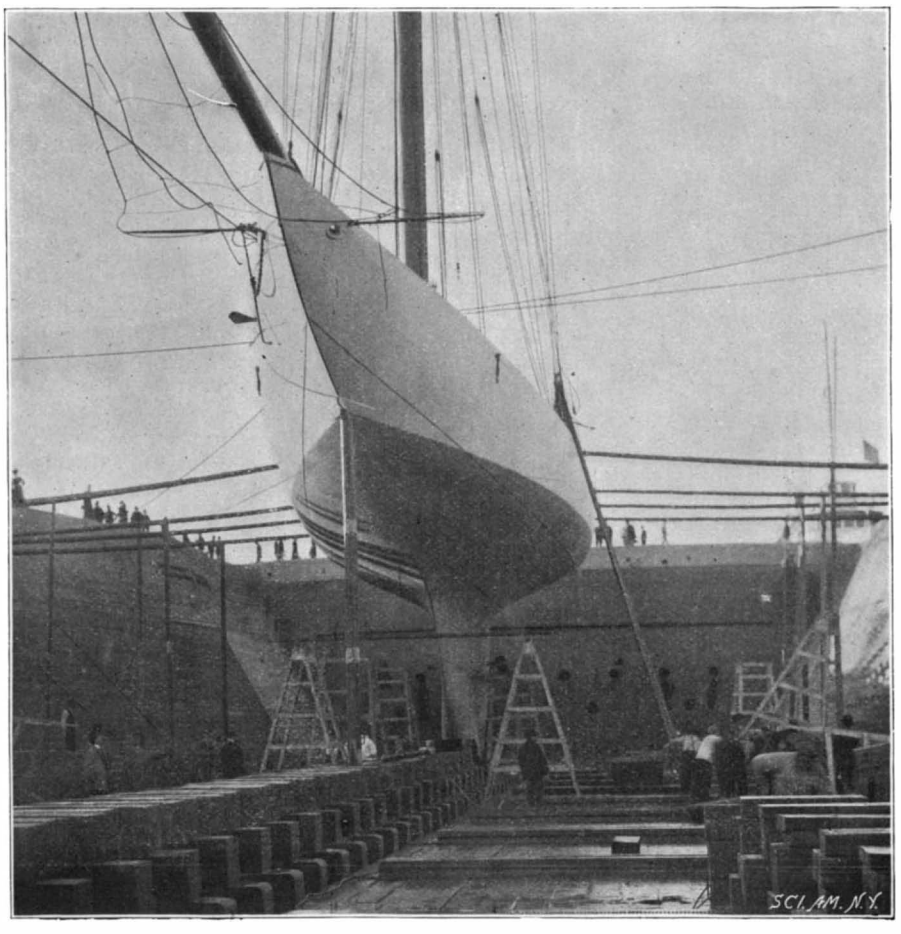
The "America's" cup was destined to repose in the lockers of the New York Yacht Club undisturbed for the next six years, or until the year 1893, when "Valkyrie II.," owned by Lord Dunraven and designed by G. L. Watson, was sent over the water with the Godspeed of all England behind it. The "Valkyrie II." was a further development in the direction of greater beam and shallower under-water body. In her profile she showed the growing tendency among



DEVELOPMENT OF THE INTERNATIONAL RACING YACHT.



DECK VIEW OF "COLUMBIA," LOOKING FORWARD.



BOW VIEW OF "COLUMBIA," SHOWING THE DEEP KEEL AND BULB-SHAPED LEAD.

English designers to reduce the wetted surface of the boat, and hence the "skin friction," by removing all useless "dead-wood." The keel forward was cut away until little was left but the hull proper, and the helm was placed well in toward the center of the boat and given a rake approaching an angle of forty-five degrees. This reduction of the lateral plane resulted in an under-water form which offered a minimum of resistance to turning when the boat was coming about; a quality which stood "Valkyrie II." in good stead when she was maneuvering for the start, or when she had the "Vigilant" placed under her lee in the windward leg of a race. The "Vigilant" was a still further development along the sloop cutter lines. On a water-line length of 86 feet 2 inches, her beam reached the unprecedented width of 26 feet, and the great draught for a sloop of 13 feet 6 inches, which, by the way, was equal to that of any previous challenger. Her total sail spread was 11,312 square feet, or 1,270 square feet more than that of "Valkyrie II." She had 55 tons of lead in her keel in addition to 29 tons of inside ballast. The "Vigilant" served to introduce Mr. Herreshoff as a builder of cup defenders, and she contained many of the original features which had characterized Mr. Herreshoff's past boats, the "Gloriana," "Wasp" and "Navahoe." She had exceptionally long over-hangs and measured 126 feet over all. She had lofty topsides and in every way was a marked departure from the model of Mr. Burgess' sloops. Her under-water body was built of Tobin bronze and her topsides of steel plating.

The first race, which should have been to windward and return, was marred by a change of the wind, which veered so as to make the race a reach in both directions, and "Valkyrie II." was beaten 5 minutes and 48 seconds. The second race over a triangular course was sailed in a strong wholesail breeze, and the "Vigilant" drew away steadily from the very start, winning by 10 minutes and 45 seconds. The third race, 15 miles to the windward and return, was sailed in a reefing wind and a rather heavy sea. It proved one of the greatest surprises in the history of yachting, for to the astonishment of the advocates of the centerboard, the deep keel cutter not only began to beat out to windward of the centerboard, but she footed faster through the water, and the crowds on the assembled excursion boats were treated to the unwonted sight of a centerboard boat being beaten on her strongest point of sailing. "Valkyrie II." turned the outer mark with a lead of 1 minute and 55 seconds, and as they started away for home, the wind increasing, it became a question whether the big sailspread of the "Vigilant" would enable her to overhaul her smaller opponent. She gained rapidly, but would have failed to close the gap and save her time allowance of 1 minute and 33 seconds, had it not been for the extraordinary ill luck of the challenger; for the "Valkyrie's" spinnaker, which had been torn slightly in setting, was blown to shreds in the strong wind, and a second spinnaker met with a like fate. The "Vigilant" passed her and managed to save her time allowance with just 40 seconds to spare.

The year 1893 was certainly a banner year in respect of the great influence which it exerted upon the science and art of yacht designing and construction, particularly with regard to the famous keel and centerboard controversy; for it happened that while Herreshoff and Watson were fighting it out with "Vigilant" and "Valkyrie" at Sandy Hook, there was a battle royal in progress in the English Channel between two other creations of these designers, the "Navahoe" and the "Britannia," which were practically sister boats to those two yachts. The outcome was strongly in favor of the keel cutter. The "Navahoe" was built by Herreshoff for Mr. Royal Phelps Carroll, for the purpose of challenging for several well known English cups, but particularly for the purpose of winning back the Brenton's Reef and Cape May cups, which had been carried across the water by the challenger of 1885, the "Genesta." The results, especially when the "Navahoe" met the "Britannia," proved the superiority of the keel type. When pitted against the "Satanita" and Fife's "Calluna," the "Navahoe" could hold her own, but in windward work against "Britannia" she was hopelessly out-classed. In the contest for the Royal Victoria Yacht Club cup the "Britannia" won the first race, sailed over a 50-mile course, by 16 minutes and 30 seconds. The second race "Britannia" won by 34 minutes and 30 seconds, and the third race by 15 minutes and 8 seconds. In her next race, which was for the recovery of the Brenton's Reef cup, the "Navahoe" was more successful. The course was from the Needles across the English Channel to Cherbourg and back, a distance of 120 knots, and the race was sailed in a strong beam wind and a heavy sea, both boats having their mainsails reefed down. It was a reach from start to finish, and the boats were never separated by more than a few boats' lengths. The "Britannia" finished a few seconds in the lead. The cup committee, however, had moved the stake boat into a more sheltered position within the Needles, and Mr. Carroll having entered a protest, the cup was awarded to the "Navahoe." The race for the Cape May cup was sailed over the same course, and was won by the "Britannia" with 36 minutes and 23 seconds to spare.

In the following year the "Vigilant" crossed the ocean to avenge her twin sister; but she met with six successive defeats in the first races in which she engaged, at the hands of the same "Britannia." In later races, however, she did better, the final score between the two boats standing at eleven in favor of the "Britannia" against six for the "Vigilant." It was the same remarkable quickness in stays and the same fine windward qualities shown by the other Watson boat, "Valkyrie II.," that carried "Britannia" so frequently to victory against "Navahoe" and "Vigilant." Mr. Herreshoff was aboard the "Vigilant" during the third race against "Valkyrie II." in 1893, and he was aboard her frequently in 1894, when "Britannia" so often had her under her lee, and the lesson of this experience was not likely to be lost in subsequent cup races. It was evident that the day of the centerboard in the "America" cup contests was over, and it was with no surprise that yachtsmen learned in 1895 that the new defender of the "America" cup was to be a keel boat.

NINTH CHALLENGE—"VALKYRIE III."

The next challenger, "Valkyrie III.," was an enlargement of "Valkyrie II.," with greater draught, 20 feet as against 17½ feet, with an increase of over 3½ feet in the beam, and the enormous increase in sail area of 3,000 square feet. It looked, indeed, when "Valkyrie III." appeared in these waters, as though Mr. Watson had determined to out-Herod Herod in the matter of beam and sail area, for the new cutter was of a greater beam than any previous cup defender, and for the first time in the history of the cup races the challenger possessed the greater sail area. She was in every way an extreme boat. The midship section of "Valkyrie III." shows the influence of the "Vigilant" on Mr. Watson in the matter of extreme overhangs and excessive beam. Following along lines on which he worked in the "Thistle" and "Valkyrie II." he had greatly increased the beam, cut further into the lateral plane, both fore and aft, and increased the draught by 2½ feet, the maximum draught of "Valkyrie III." reaching the great depth of 20 feet.

On the other hand, the influence of the races of 1893 and 1894 on Mr. Herreshoff is seen in the comparison of the midship section and sheer plan of "Defender" with that of "Vigilant" and "Valkyrie II." As compared with "Vigilant" he has abandoned the great beam, moderate draught (moderate as compared with the deep keel cutters), the long, straight keel, the small rake of the stern post and rudder; and as compared with "Valkyrie II." he has adopted the moderate beam, the deep draught (in the case of the "Defender" no less than 5½ feet more than that of the "Vigilant"), the short rockered keel, and the raking stern post placed well in under the boat. But as a final and most startling innovation of all in an international "America" cup champion, he has thrown out the national, time-honored centerboard. The genius of Mr. Herreshoff and his originality, however, were shown in the matter of the construction, in which his knowledge of the strength of materials and their structural possibilities gave him a vast advantage, and, indeed, practically won a race for the "Defender" before the ships had crossed the starting line. By using a high quality of bronze for the under-water body of the ship and an aluminum alloy for the topsides, the deck frames and general fittings, he saved at least 7 tons dead weight in the structure of the hull. It is safe to say that the "Defender" was by far the lightest sailing yacht that had ever been constructed in the history of yacht-racing.

In the first race, which was to have been 15 miles to windward and return, the wind shifted, as it so frequently does over this course, so as to change the windward and leeward work into reaching. Going to the outer mark, in what windward work there was the boats seemed to be very evenly matched; but immediately on turning the mark, the "Defender" in a reaching wind literally ran away from "Valkyrie III." and won the race by 8 minutes and 49 seconds. In the second race over a 30-mile triangular course, "Valkyrie III." in straightening for the line fouled the "Defender" and carried away her topmast starboard spreader, springing the topmast and seriously crippling the boat. The "Defender," however, sailed over the course and actually gained 15 seconds on one leg and 1 minute and 17 seconds on the last leg of the trial, losing the race by only 48 seconds. This was a virtual victory for the "Defender" and removed any doubt as to her superiority. At the last race of the series, Lord Dunraven, the principal owner of "Valkyrie III.," crossed the line under reduced canvas in order to make the race count as one of the series, but immediately withdrew, his ostensible reason being that the course was overcrowded with excursion boats. This brought to a close the most disappointing and unsatisfactory series of races in the history of the "America's" cup; but that the "Defender" is a superior boat to the "Valkyrie III." was proved to the satisfaction of all yachtsmen who witnessed the contests.

TENTH CHALLENGE—"SHAMROCK."

Four years have elapsed since "Valkyrie III." was dismantled and laid up to rot in an English yard. The present revival of interest in the cup contests is due to Sir Thomas Lipton, whose challenge was sent through the Royal Ulster Yacht Club of Belfast. It was the intention of Sir Thomas to have the challenger built in Ireland and manned by an Irish crew. Hence she was given the suggestive name of "Shamrock." It was realized, however, that in order to construct a yacht to match the constructive skill of Herreshoff, it would be necessary to go to a builder of torpedo boats, and accordingly the order was placed in the Thornycroft yards. The "Shamrock" introduced another designer into the cup contest in the person of William Fife, Junior, whose success in the smaller classes has placed him in the very front rank on the other side of the water. The order for the American yacht was of course given to Herreshoff, and the result was the most beautiful example of yacht designing and construction ever seen in the history of the contest.

The two boats are so fully discussed in our editorial columns that it is unnecessary to add anything further in the present article. We will close by drawing attention to the fact that, in the form of their hulls, the American and English yachts of 1899 exhibit a curious transposition of ideas as compared with the "America" and her competitors of 1851. The rather full bow, the deep body and the long, fine run and tapering stern of the "Columbia" are somewhat suggestive of the cutter model of half a century ago. On the other hand, the long, sharp entrance, combined with the full quarters and stern of the "Shamrock," are equally suggestive of the old "America." This comparison is drawn, of course, without any reference to the deep fin-keels, and is merely offered to show that, as regards many features in the form of the hulls, the types have crossed in the gradual development of the past fifty years.

A Double Conduit for Street Railways.

A difficult piece of track conversion is being carried on in New York, where both the Metropolitan Street Railway Company and the Third Avenue Railway Company possess the right of way through the same street. To operate the latter company's line by independent power system required a separate pair of power rails in separate conduits. The Metropolitan conduit had already been installed for a year and a half, so the Third Avenue Company is pushing the present conduit over to one side to give room for the other conduit beside it, between the two rails of the track. The difficulties are numerous in view of the fact that the track is kept constantly in service for the Amsterdam Avenue cars, so that the men have to work alongside rails which are constantly charged. The pavement is first removed and the concrete foundation and conduit wall are broken up and removed from around the yokes and conductor rail. The track is shored up to carry the cars which are constantly running over it. Temporary wooden yokes are inserted to maintain the gauge of the track, and the old yokes are loosened and pushed to one side, carrying with them the old slot rails, insulators and conductor rails. The conductor rails are then removed in single lengths and the free ends are fitted with slippers to prevent the shoes on the plows from being carried away. The old yokes are promptly removed and replaced by new ones fitted for the two conduits which are symmetrically placed between the track rails. While each company will have its own source of power, both will use the same rails.

A Prize for a Beet-Lifting Machine.

Among agricultural implements needed in cultivating the sugar beet no machine is more valuable than a good beet-digger. In fact, some device of this kind is absolutely indispensable. Quite a number of such machines have already been put on the market, but in order to determine which is the best the Deutsche Landwirthschaft-Gesellschaft has offered a prize competition. The premium amounts to $130. The examination of the competing machines will be held in the fall of 1900. An additional prize will be given to a machine which will raise and top the beets at the same time. This prize may, at first sight, seem rather small for an important piece of agricultural machinery, but it is to be supplemented by prizes offered by the Verein der Deutschen Zuckerindustrie, or the Association of the German Sugar Industry, which has offered prizes amounting to $1,904 and $2,380. Our United States consul at Magdeburg says that these prizes will be given to machines that are not only the best that are exhibited in the competition of the farming association, but that in addition must come up to certain other requirements and specifications which will be set forth later on. The competition is not restricted to German manufacturers, and foreigners will also be admitted. This is one of the instances in which there is a legitimate prize offered for an invention.

THE MAGICIAN'S OMELETTE.

BY WILLIAM B. CAULK.

The magician has never proved himself an adept at the art of cooking, from an epicure's standpoint, yet the ease with which he can bake cakes in borrowed hats and cook omelettes in empty pans has long been a source of wonder to the economical housewife as well as to the professional cook.

To see the magician hold a small, shallow, empty pan over the blaze of a spirit lamp for a few moments, when an omelette, done to a turn, appears in the pan and is cut up and distributed to the audience, one is almost convinced that at least one person has solved that most perplexing of all problems, how to live without work.

But has he solved it? No! my friend, no more than you or I. He has merely deceived you, but most cleverly, you must admit.

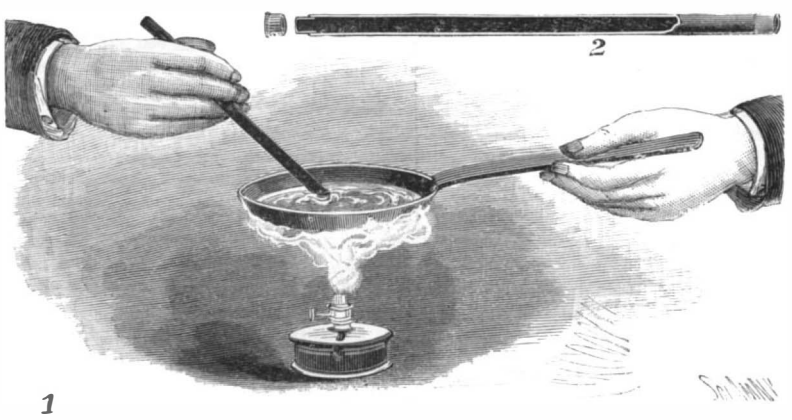
The pan is without any preparation whatever, but so much cannot be said of the wand, which he is continually stirring around in the pan. This wand is hollow, with an opening at one end only, and in the wand, previous to the trick, of course, is placed the properly seasoned ingredients of an omelette, after which the end is closed with a metal plug that is turned and enameled to correspond with the opposite end of the wand.

When the pan is being examined, the performer is holding the wand in his hand, and such an innocent-appearing black stick is never suspected of being in any way connected with the trick.

Just before holding the pan over the lamp the performer finds it a most easy matter to remove the plug from the end of the wand, when by holding the wand by the closed end he can empty the contents into the pan in the mere act of passing the open end of the wand around the inside of the pan.

The metal of which the pan is made being thin, and there not being a great quantity of the omelette, assisted by a large flame from the lamp, it only requires a few moments to cook the omelette, when it is turned out on a plate and carried down to the audience.

It is hardly necessary to say that when the cooked omelette is carried down, the wand is left on the stand, which prevents any inquisitive person asking to see it.

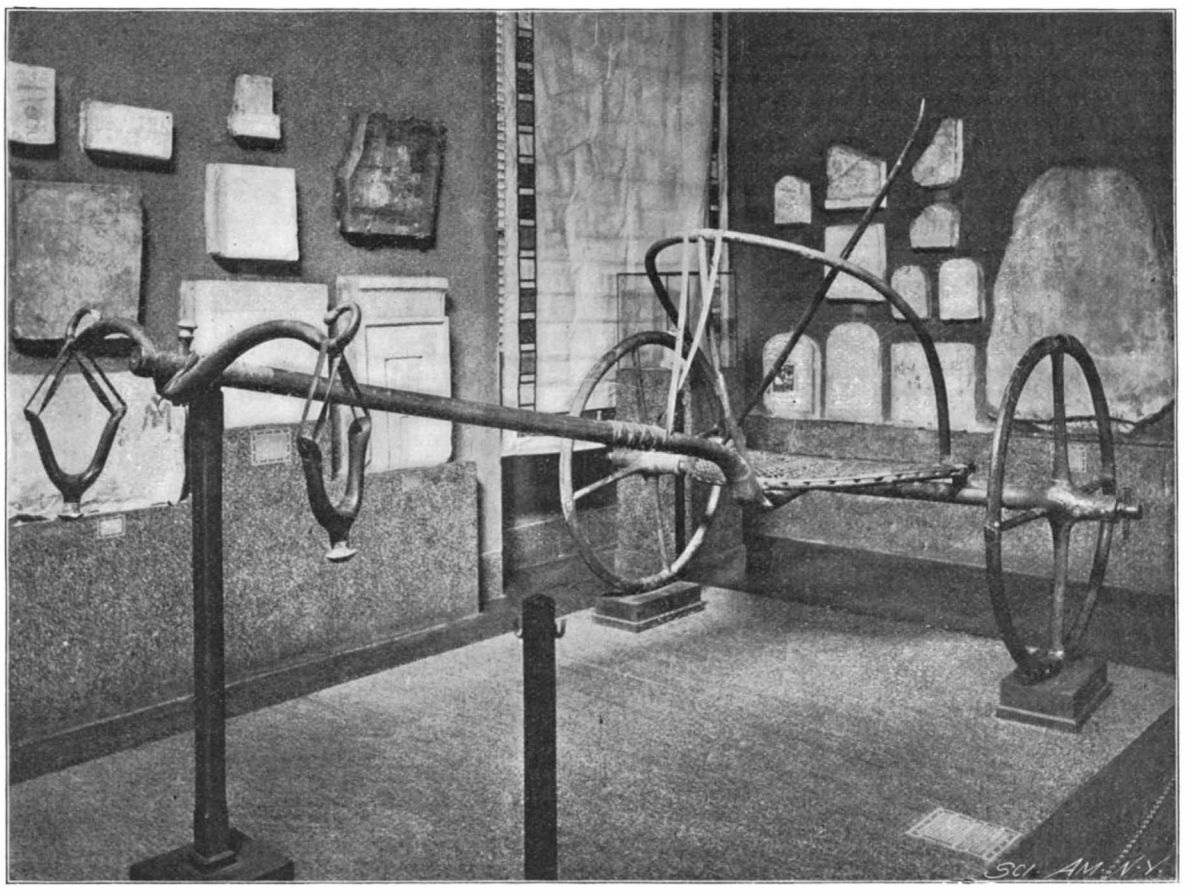


THE MAGICIAN'S OMELETTE.

THE BATTLE CHARIOT.

The chariot was used in antiquity for the battle, the chase, in public processions and in games. It had two wheels and was drawn by two horses, and when one or two horses were added they were attached to each side of the main pair by a side trace, fastened to the front of the chariot. These chariots have only come down to us in fragments, with the exception of the one in the Archæological Museum of Florence, which is a unique example of a war chariot, the so-called "Biga di Frassino," found by Rosselineo in a tomb at Thebes. It is certainly as old as the fourteenth century B. C. It is probably a trophy obtained in the north by some Egyptian warrior. There is an entire absence of metal in the construction. Immediately on the axle without springs of any kind rests the basket or body of the chariot, which consisted of a floor to stand on, and a semi-circular guard around the front and about half the height of the driver. It is entirely open at the back, so that the combatants might leap to the ground and up again as became necessary by the exigencies of action. There was no seat, and generally in war chariots there was only room for the combatant and his charioteer to stand in. The pole as in the present instance was usually attached to the middle of the axle, although to outward appearances it looked as though it sprang from the front of the basket. At the end of the pole was the yoke, which looked like a ram's horns. Depending from this by leather thongs was a Y-shaped piece, which preferably took the place of the modern horse collar. Probably broad bands were also fitted around the chest of the animals. Besides the harness of each horse there was a bridle and a pair of reins somewhat in the same style as in use at the present day. These were made of leather and were ornamented with studs of ivory and metal. The reins were passed through rings attached to the collar and were long enough to be tied around the waist of the charioteer in case of his having to defend himself. The wheels and body were usually of wood strengthened in places with bronze or iron. The wheels had from four to eight spokes and the tires were of bronze or iron (in the present instance ash was used) and the pins which secured the felloes were of fossil bone. This description applied to the chariots of almost any of the nations of antiquity, the difference consisting chiefly in the mountings. Thus the chariots of the Egyptians and Assyrians, with whom the bow was the principal arm of attack, were richly mounted with quivers full of arrows, while those of the Greeks, who used the spear, were plain except as regards mere decorations. The Persians and the ancient Britons used a class of chariots having the wheels mounted with sharp, sickle-shaped blades which cut to pieces whatever came in their way. This was probably the invention of the Persians.

The use of the battle chariot really belongs to the heroic period. The warrior standing by the side of his charioteer was driven in front of the line to invite hostile warriors to single combat. After the strategic skill of a commander superseded the demands on his personal valor, the chariot was transferred from the battlefield to the hippodrome, where alone its original form was preserved. The description of the Homeric battle chariot therefore to a great extent also applies to the historic chariot of the race course. The small diameter of the chariot wheel may be explained from the desire of preventing the chariot from being opposed by the impediments in the battlefield, such as debris or dead bodies. The rim was usually formed of four felloes in which the four spokes were let. The upper rail, which was of either wood or metal, varies greatly in form and was intended to be grasped by the warrior on jumping onto the chariot, while the front part served for fastening the reins and the traces of the "wheel horses." In the Roman triumphal chariot a covering of leather served to ward off missiles, and later on the sides were composed of strong boards. Unfortunately we know very little of the vehicles of every-day use. They nearly all seem to be a variety of what we now term the "gig."



THE ONLY PERFECT WAR CHARIOT OF ANTIQUITY—THE "BIGA DI FRASSINO."

American Physical Development.

Dr. Angelo Mosso, while in America, made a minute study of the system of physical education, particularly as carried out at the athletic clubs of the American seats of learning, says The London Lancet. Referring to the Boston Gymnasium, he says: "The interest and the wonder with which these academic adjuncts inspire me awaken a sense of melancholy when I think how far we in Italy are removed from such perfection. It is enough," he adds, "to look at the passers-by in the American streets to be convinced how much more developed and strong they are than our compatriots. The boys and girls are in point of physique far superior to ours. All the public takes interest in physical exercises—every journal being compelled to report athletic competitions, regattas, football encounters, golf matches, and such like, because its readers have even a greater enthusiasm for those topics than for the strife of parties. America teaches us, by the plainest and most impressive of examples, that physical education may be carried to perfection without any military object. In the States no one dreams of becoming a soldier. If military force is required it is provided, as in Great Britain, by voluntary enlistment. Nevertheless, America and the British Isles are precisely the two countries where physical education has reached its highest development. My admiration for this New World is all the greater when I reflect that its civilization is that of the future, which, even for Italy, will have better days in store."

October Building Edition.

The SCIENTIFIC AMERICAN Building Edition for October is a beautiful number of this unique periodical. The cover, which is in colors, is a modern cottage at Larchmont, New York. The artistic features of the number include F. W. Ruckstuhl's "Wisdom," the late Cornelius Vanderbilt's residence, the "Breakers," at Newport, and Golden Gate Park, at San Francisco, an elaborately illustrated article showing the attractive features of this wonderful park. The houses which have been selected for this number are of unusual variety and excellence and include brick, half-timbered, clapboard, shingle houses and inexpensive "bungalows."

The Current Supplement.

The current SUPPLEMENT, No. 1241, has a superb view of the Dewey arch erected in New York city as a decoration during the recent fêtes. The construction of the arch is the subject of a full article. "Acetylene for Lantern and Enlarging" is discussed. "Works of the Diamond Match Company" is continued and illustrates the elaborate machinery employed. "Robert Wilhelm Bunsen" is a full biography. "An Advance in Measuring and Photographing Sound," by Prof. Benjamin F. Sharpe, is an important paper on physics elaborately illustrated. "Boats and Sails—Tools for Testing Boat Models," by Walter Burnham, is a most important and critical study and is fully illustrated. "The Modern Warship as Combining in Itself the Highest Results of Skill, Ingenuity, and Scientific Knowledge" is an address by Rear Admiral George W. Melville, Engineer-in-Chief, United States Navy, and was delivered on the occasion of the seventy-fifth anniversary of the founding of the Franklin Institute.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

POTATO-PLANTER.—Leonard Heaphy, Watertown, S. D. This invention provides a potato-planter which can be attached to any gang, sulky, or other wheeled plow, and which will drop either whole or cut potatoes at regular intervals into a furrow which has been made before planting, the potatoes falling to the right-hand side of the furrow directly in front of the soil, being turned so that they will be covered as soon as they are dropped.

CULTIVATOR.—Louis P. Rife, Defiance, Ohio. The invention provides means for shifting the axle by the same movement by which the cultivator-shovels are raised or lowered, thus changing the fulcrum so that the weight and downward pull on the necks of the horses is uniformly maintained, whether the shovels be raised or lowered. The axle may be shifted and the shovel-beams simultaneously raised or lowered either by hand or horse power. The shovel-beams may be raised independently of the axle. A tension-device is provided, so applied to the levers controlling the movement of the shovel-beams that neither the team nor the driver need raise the dead-weight of the shovel-beams.

Electrical Apparatus.

STATIC ELECTRIC MACHINE.—José Gallegos, San José de Guatemala, Guatemala. A wheel is provided carrying a series of movable coils arranged to pass adjacent to statically-excited stationary coils, the coils at their opposing ends carrying metal plates separated by an insulating-cylinder. The electricity is received by collectors, the number of which is double that of the stationary coils. One-half of the collectors are constructed to connect the movable coils with the ground when they register with the stationary coils; and the other collecting devices are arranged to connect the movable coils with a consumption apparatus when they are in an intermediate position. The machine is double and receives and yields both positive and negative electricity.

Engineering-Improvements.

BOILER.—George Kingsley, Montreal, Canada. Improvements in boiler-construction have been made by this inventor, whereby the boiler-parts are made readily accessible and the heat of the fuel utilized to the utmost profit. The boiler consists of an inner and an outer shell forming a water and steam compartment between the shells. A horizontal partition in the inner shells forms upper and lower flame-compartments connected with each other at their rear ends. The fire-box is situated in the front end of the lower compartment. Horizontal water-tubes project from the sides of the inner shell into the lower compartments; and water-tubes depend from the crown-sheet in the upper-flame compartment and terminate above the partition. A transverse deflector is located between the top of the partition and the lower ends of the depending tubes.

COMBUSTION-MOTOR.—Rudolf Mewes, Berlin, Germany. In this motor the gaseous or sprayed fuel, or a mixture of gaseous, liquefied, sprayed, or pulverized fuel, or the air employed for feeding in pulverized solid fuel, is compressed to such an extent as to heat it to a temperature above the ignition temperature and is, thereupon, forced under pressure either into the cylinder, which is supplied with compressed air at a lower temperature, or into a vessel in communication therewith serving as a combustion-chamber. By this means the air conducted to the working-cylinder to support combustion may be cold and the temperature during the process may be kept as low as permissible, according to the constructional parts, packing, etc., employed.

ROTARY ENGINE.—Thomas Croston, Hoquiam, Wash. The engine is provided with a cylinder in which a piston is mounted and with a cut-off valve for the steam. The main driving-shaft controls the valve. Between the shaft and piston is a yielding connection comprising disks spring-pressed apart and engaged by and carried around by the piston. One of the disks is fitted to slide in spiral grooves on the shaft. The disks are shifted simultaneously and automatically on reversing the engine. It is probably a new departure in rotary-engine-construction to control the engine automatically according to the load and to indicate the horse-power, both of which features constitute noteworthy points in this invention.

Mechanical Devices.

PENDULUM-ESCAPEMENT.—Carl T. E. Zimmerman, Cumberland, Wis. The ordinary clock does not keep correct time owing to the varying tension of the spring. The present invention is designed to overcome this objection by a peculiar construction and arrangement of the parts of an escapement, so combined with the pendulum and an escapement-wheel that the pendulum is not actuated by the escapement-wheel and the variable power of the mainspring, but by an intermediate weight set into action by the escapement-wheel and falling with a constant force to actuate the pendulum uniformly.

SAFETY-LOCK FOR BREECH-LOADING GUNS.—Jasper L. Ackerman. Monon, Ind. Sometimes a breech-loading gun is opened and cocked and the hammer snapped down by curious meddlers when the gun is not loaded, to the great damage of the firing-pins; and the safety-slide is innocently changed without the knowledge of the user of the gun, thus locking the safety, so as to cause the gunner to miss his shot. The present invention provides a device for locking the break-lever of the gun, so that it cannot be opened or broken down, and for locking the safety-slide of a hammerless gun so that the slide cannot be meddled with.

REVERSING MECHANISM.—George V. Blackstone, Jamestown, N. Y. The object of the invention is to provide a gearing for washing and other machines which, in operation, requires but little power. The gearing comprises a driving-pinion with which a cam moves. Gear-wheels mesh with the pinion at opposite sides. On the shaft to be driven is a locking device having a fixed member, and a locking member fitted to slide in the fixed member and adapted to be engaged by the cam to throw the locking member alternately into engagement with the gear-wheels.

PRINTING-MACHINE.—Edward G. Smith, Manhattan, New York city. The invention relates to high speed, multicolor-printing machines for printing wall-paper, textile fabrics and other endless webs. The machine has a row of impression-cylinders, a printing-roller for each cylinder, and driven endless feed-bands passing between the cylinders and the printing-rollers to carry the web at its margin between the sets of printing-rollers. The bands pass through annular grooves formed on the printing-rollers to hold the web in proper position between the opposite contacting portions of the cylinders and rollers. By running the web in a straight line through the sets of cylinders and rollers, it is evident that no undue strain is given to the web, and the latter readily takes up the ink or color delivered by the printing-rollers.

MACHINE FOR CUTTING SUGAR.—Francis Simonet, Manhattan, New York city. This machine is designed to cut sugar when in the nature of a paste, the object being to provide improvements for the purpose of obtaining clearly-cut pieces and of more readily cleaning the machine of waste. The novel features of the machine are found in the use of a supporting plate located in the meeting plane of two dies and of a conveyer which carries the candy or sugar over the plate. One of the dies rotates, and the other both reciprocates and rotates in order that it may be readily cleaned. Indeed, the ease with which the dies can be cleaned constitutes one of the merits of the invention.

BASCULE LIFT-BRIDGE.—John P. Cowing, Cleveland, Ohio. This revolving bascule bridge has a span with a segmental bearing-surface engaging a rolling-surface, and supports for the end of the span when the latter is closed. The supports are independent of the rolling-surface, so that this surface is relieved of the strain of the live or moving load. The strain in question is transmitted by the supports to the abutments or piers. This in brief is the broad idea of this new construction. It is expressly understood that it is the rolling-surface which carries the dead weight of the span when the span is open, but when the bridge is closed, the principal strain, as we have already remarked, is borne by the abutments. The bridge possesses the additional advantage of being self-contained, since the motive power for opening and closing the span is located on the supporting-piers, without therefore requiring any approach spans.

APPARATUS FOR WEIGHING, MEASURING, AND DELIVERING PROVISIONS.—William D. Wanzer, Clintondale, N. Y. The apparatus is designed particularly for storing and measuring out coffee in variable quantities and for grinding and delivering it to the customer. The apparatus has receptacles for various brands of coffee. Valves control these receptacles; and a scale is arranged below to receive the coffee. When the desired weight of coffee is discharged into the scale-pan, the scale-beam is tilted, thus throwing into action mechanism which automatically closes the valves and discharges the coffee into a mill, by which it may be ground and from which it is delivered to the customer.

LOCK.—Detalmo di Brazza Savorgnan, Rome, Italy. This invention provides improvements in locks more particularly designed for use in connection with mail-collecting bags and mail-boxes, the object being to provide a comparatively simple lock in which a multiplicity of cylinders is employed. The cylinders are provided with variously-pitched channels, so that there will be a variation of speed of movement between coacting cylinders, thus making it practically impossible to operate the lock with any other than the proper key.

CORDAGE-MACHINE.—Franz J. F. Graf, Passaic, N. J. It is the purpose of this invention to provide an improved cordage-machine for manufacturing ropes, cords, and cables, without requiring long rope-walks and skilled mechanics, the machine being capable of turning out a large quantity of rope of a high quality in a comparatively short time. The machine comprises a revoluble frame arranged for carrying a number of bobbins. A drawing device is used for each bobbin to draw the strands therefrom; and a flier carries the drawing device to rotate it around the bobbin. Mechanism is provided for rotating the flier; and a twisting device receives the strands from the several drawing devices.

Railway-Contrivances.

LOCOMOTIVE.—Alfred Given, Ellensburg, Wash. The locomotive is driven, not by a reciprocating engine, but by a rotary engine mounted in the front portion of the locomotive and connected by connecting-rods with the driving-wheels. The construction of the locomotive has been slightly modified to meet the demands of the new form of driving mechanism. The locomotive is considerably simplified by the new arrangement, since the usual cylinders and parts thereon depending are dispensed with.

PARTITIONING DEVICE FOR RAILROAD-CARS.—William H. Gummere, South Bethlehem, Pa. The partitioning device is designed to form a space in a car for the use of the government in safely carrying packages in bond. When not in use, the device permits the car to be used in the customary manner. The car is provided in its interior with an overhead, longitudinally-extending track on which carriages are mounted to travel. A transverse partition is carried by the carriages and is adapted to be locked to the car.

Miscellaneous Inventions.

LIQUID-MEASURE.—Henry J. Brantley, Valdosta, Ga. In connection with a barrel or tank, a dispensing vessel is used, through which the liquid is discharged. This vessel is provided with means whereby the discharge of liquid is closed when the liquid is entering from the cask; and the supply of liquid from the cask is shut off when the outlet port of the vessel is opened. Registering devices indicate automatically and accurately the precise quantity of liquid drawn. By this means the purchaser of a barrel of liquid is able, when the barrel is empty, to determine exactly how much liquid was in the barrel.

AUTOMATIC CHEMICAL FIRE-EXTINGUISHING SYSTEM.—Henry Bush, Dayton, Ohio. The inventor has devised a fire-extinguishing system, whereby in the absence of watchmen, the heat of a fire would automatically release one or more discharge-valves in the line of distributing-pipes and by such release and consequent reduction of pressure in the pipes permit the automatic action of mechanism for causing the generation of gas in a vessel or tank. This vessel first discharges its gaseous and liquid contents through the distributing-pipes upon the fire. At the same time an alarm is sent to a fire-department. When the discharging-vessel is exhausted, a second source of constant water supply is automatically turned on, so that, should the alarm be unheeded, there would be no cessation of discharge of water upon the fire.

LETTER-CARRIER'S BAG.—Michael McCarthy, Boston, Mass. It is object of the invention to provide a means whereby letter-carriers may stow in their boxes or satchels the letters gathered so that the letters may be taken out in the order of the route, thereby avoiding the use of twine in tying up the bundles of letters and saving time. To this end the usual bag is furnished with a box or holder fitted in one end and having flaps at its front side, which may be connected or disconnected to permit the placing and displacing of the letters to be stacked in the box or holder.

PICK OR PLECTRUM.—Frederick Menzenhauer, Jersey City, N. J. The pick is designed to be used in connection with mechanically-actuated stringed musical instruments and is arranged to combine the desired flexibility with the necessary strength. The pick comprises a body having a recess in which a coiled spring is held projecting beyond the body. The spring at its outer end is provided with a point, and at its inner end with a stiffening-rod.

STRINGED MUSICAL INSTRUMENT.—Frederick Menzenhauer, Jersey City, N. J. The strings of this musical instrument can be readily picked either singly or in groups to sound chords. The instrument can be played with but little knowledge of music. The instrument is provided with a pick-board having a limited movement across the strings. A number of picks—of the kind described in the foregoing notice—one for each string, are mounted in the pick-board to move therewith. These picks stand normally above the strings; and each pick moves at an angle to the movement of the pick-board, so that when the pick is pressed and the pick-board is moved, the pick picks its string.

DEVELOPING-TRAY.—Auley B. Sheppard, South Burgettstown, Pa. The tray has overhanging sides to form a partial cover, the ends of the bottom being gradually curved upward in the form of a rocker, whereby the tray may be rocked to flow the developer over the plate without spilling. The tray is made of glass and is graduated so that the developer can be measured. By reason of the peculiar construction, the solution can be effectively applied without spilling and without staining the hands.

PHOTOGRAPHIC WASHING APPARATUS.—Augustus Studdiford, Liberty, N. Y. The tank of the apparatus is formed with a well and contains a tray-carrying wheel. Extending down into the well is a pipe provided at its end with a nozzle adapted to throw a jet of water against the wheel. A branch pipe above the nozzle and in the upper part of the tank is provided with a sprinkler whereby to spray the trays while the tank refills after being emptied by a siphon mounted in the well. A very thorough washing of films, plates, and prints can thus be obtained without special manipulation of the trays.

SHIRT-WAIST ATTACHMENT.—Charlotte E. Hurd, Unadilla, N. Y. The attachment is designed to enable a skirt to be utilized for holding a waist in proper position so that no space will be visible between a waist and skirt. The device is so constructed that a pliable member will be a fixture upon the waist, which member can be readily passed through the wash. The attachment is not uncomfortable when worn and is invisible when in use.

TOOL-HOLDER.—Frank B. Kendrick, Lebanon, N. H. The present device is a novel tool-holder which can be operated with one hand and in which spring-tempered jaws are provided that automatically open when released from the pressure of a regulating device. This regulating device also serves to close the jaws upon the tool, the jaws being then locked so as to grip the tool. The device can also be used as a pin-vise or as an ordinary clutch for light work.

POCKET-KNIFE.—Ernst Kühn, Untenkatternberg, Prussia, Germany. In this pocket-knife a very simple substitution is provided for the springs usually employed, by which the knife-blade can be held firmly in position. In the handle of the knife the usual blade is pivoted. An arm is mounted on the pivot of the blade to move therewith. The arm serves to engage the handle to hold the blade locked in open or closed position.

MATCH-SAFE.—John C. Gilbert, Boston, Mass. On a bracket or support a human figure is mounted. A rock-shaft is journaled in the figure and carries the figure's movable arms; while a cord is wound over the rock-shaft and is connected with the movable leg. When the leg is pulled, the shaft is turned so as to cause the arms to swing up and lift the cover from the match-box.

Designs.

BROOM-COVER.—Oscar S. Kulman, Savannah, Ga. The purpose of the cover is to keep the Kulman antiseptic broom, or any other broom, clean during shipment, to preserve its shape, and to prevent the evaporation of the disinfecting or antiseptic matter.

CLOTHES-LINE PULLEY.—Thomas Rubino, Hazleton, Pa. The leading feature of the design is found in a plate having divergent slots. The lines are placed in these slots and are thus prevented from becoming entangled, and are held in proper position.

DIAPER.—William M. Stinson, Louisville, Ky. The design consists of a middle portion and integral end pieces and extending beyond both sides of the shank, with the end piece arched at its outer edge and half round at the sides. The outer edge of the end piece is straight and the sides rounded off. The end piece has cuts to form flaps.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Notes & Queries

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(7732) T. W. says: Will you oblige me by letting me know by mail receipt for substitute for white lead. I am looking for a cheap white paint, for out door work; something that will stand weather fairly well, and that could be painted over should the occasion require it. A. Skim milk, 2 qts.; fresh slaked lime, 8 oz.; linseed oil, 6 oz.; white Burgundy pitch, 2 oz.; Spanish white 3 lb. The lime to be slaked in water, exposed to the air, and mixed in one-fourth the milk. Dissolve the pitch in the oil and add a little at a time. Then add the rest of the milk and the Spanish white.

(7733) S. G. asks: Which is the proper side of a leather belt to run next the pulley, the grain side or flesh side? A. The question as to which side of a belt should run next to the pulley has been a subject of discussion among mechanics since the earlier days of the use of belting. It has been proved that a belt pulls harder, or with less strain, with the grain side next the pulley. Still, we see almost universally the better-looking side of the belt on the outside, with belt grease and wax used to make it stick.

NEW BOOKS, ETC.

Inorganic Chemical Preparations. By Phelix Lengfeld. New York: The Macmillan Company. 1899. 16mo. Pp. 58. Price 60 cents.

This manual is written for the classes in inorganic preparations at the University of Chicago, and is an excellent laboratory guide. The directions are simple and the student cannot go wrong if he follows them. The preparations are arranged in the order of increasing difficulty. It is an excellent contribution to modern text books on chemistry.

Embroidery, or the Craft of the Needle. By W. G. Paulson Townsend. Assisted by Louisa T. Pesel and Others. With Preface by Walter Crane. London and New York: Truslove, Hanson & Comba. 1899. 16mo. Pp. 116.

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INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

OCTOBER 3, 1899,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Acid from alkaline acetates, extracting acetic, H. Plater-Syberg 634,271
Adhesive and making same, J. W. Wachter 634,047
Adjusting mechanism, J. Kennedy 634,088
Advertisements, signs, etc., electrical apparatus for exhibiting and changing, A. D. Douglass 634,403
Advertising apparatus, Sonneborn & Kammerer. 634,248
Air compressing engine, direct acting, P. Brotherhood 634,389
Alarm. See Time alarm.
Album, F. H. Gilson 634,294
Annunciator, electric, C. E. Scribner 634,095
Applicator, W. A. Morrison 634,363
Armor plates, carburizing, J. S. Unger 634,251
Axle, carriage or wagon, L. F. Stanton 634,151
Basin, catch, J. J. Mahony 634,011
Bearing, ball, C. F. Eberhard 633,990
Bearing for vehicle wheels, ball, W. R. Sr., & W. R. Spruill, Jr 634,150
Bed, iron, Pack & Philippi 634,065
Bed, folding metal, A. Holm 634,110
Belt, electric, L. A. Dixon 634,231
Belt tightener, Davies & Hughes 634,055
Bicycle, W. M. Sweet 634,098
Bicycle brake, P. T. Volkman 634,046
Bicycle brake, Witte & Luick 634,421
Bicycle frame, H. W. Libbey 634,089
Bicycle gearing, V. Weber 634,252
Bicycle support, W. H. Hart, Jr. ..... 634,296 to 634,298
Binding, skirt, W. J. Hay 634,264
Blackboard, W. J. Semelroth 634,149
Bladder, C. E. Longden 634,302
Boats from vessels, means for launching life, Pollitz & Cox 634,028
Boiler. See Steam boiler. Water tube boiler.
Boiler, Addicks & Williamson 634,127
Boiler furnace, S. W. Butterfield 634,391
Boiler tube cleaner, Forsyth & Bell 634,406
Boiler tube cleaner and driver, A. A. Patton 634,270
Bolt holder, E. T. Clowe 634,392
Book, E. L. Heydecker 634,265
Book, writing, E. E. Roudebush 634,094
Boot or shoe counters, machine for forming, Dancel & Scott 634,397
Bottle case cushion, B. Kochs 634,355
Bottle, non-refillable, W. R. Phillips 634,184
Box. See Coin and check collecting box. File box. Letter box. Lunch box. Mill box. Paper box.
Box making machine, Crawford & Bullard (reissue) 11,776
Box or can provided with means for opening same, A. Cameron, Jr 633,986
Bracket. See Shade bracket. Shelf bracket.
Brake. See Bicycle brake. Car brake. Wagon brake.
Brake mechanism, safety, C. S. Miller 634,305
Brake shoe, spring, A. H. Peterson 634,152
Brick truck, M. Villaret 634,044
Bridge, trussed suspension, W. H. H. Pittman 634,026
Broiling, roasting, or toasting device, J. Walton. 634,224
Broom moistener, H. P. Smith 634,097
Brush, blacking, E. P. Le Compte 634,059
Bucket, ventilated lunch, M. Gilmore 634,132
Bullet, T. W. Webley 634,383
Bung, J. Conrad 634,394
Burial crane, M. B. Lemley 634,008
Burner. See Oil burner. Prickly pear or cactus burner.
Bustle, T. P. Taylor 634,153
Butter cake forming and printing machine, F. Krabal 634,300
Button finishing machine, T. F. Morrissey 634,306
Button, metallic, O. W. Ketchum 634,173
Button, separable, A. Ducommun 634,056
Cakes, preparing cereal, J. H. Kellogg 634,003
Calculator, W. D. Conklin 633,989
Calendar holder, E. A. Henkle 634,343
Calking tool, electric seam, E. T. Thomas 634,315
Camera multiplying attachment, J. L. Atwater 633,980
Can, J. H. Leslie 634,243
Can cap wiring mechanism, H. H. Hull 634,112
Can opener, C. S. Hopper 634,111
Canvas holder, artist's, P. McDonough 634,064
Car brake, L. L. Logan 634,357
Car check holder, mine, C. R. Williams 634,049
Car construction, H. H. Sessions 634,218
Car coupling, A. R. Heath 634,341
Car fender, P. Nilsson 634,092
Car loading apparatus, grain, J. C. McIntosh 634,122
Car, railway, Curwen & Brill 634,396
Car replacer, I. H. Wise 634,100
Car side bearing, S. P. Bush 634,323
Car, street railway, J. W. Evans 634,234
Car wheel, H. F. & G. F. Shaw 634,036
Car wheel, J. B. West 634,280
Car wheels, ladle for casting, A. J. Fisher 633,991
Cars, electric lighting system for, J. L. Crevelling 634,286
Carbid cartridge shell, D. M. Dorman 634,402
Carpet renovator, pneumatic, J. S. Thurman 634,042
Carts, etc., covering for ash, T. Hill 633,999
Carving device, H. Deptner 634,287
Case. See Ticket case.
Cattle tie, A. Bynell 634,129
Chair. See Dental chair. Swinging chair.
Churn, W. F. Fribley 634,408
Churn and butter worker, combined, Virtue & Deeg 634,074
Churn dasher, W. H. Swan 634,377
Cigar, B. Fanta 634,104
Clamp. See Seat post clamp.
Cleaner. See Boiler tube cleaner. Cotton cleaner.
Clock, repeating alarm, M. C. Jensen 634,353
Clothes drier, C. S. Solomon 634,222
Clothes pin, O. I. Bergeron 633,981
Clothes rack, J. H. Clough 633,987
Cock or valve, M. M. Brophy 634,197
Coffee percolating package, H. M. Humphrey 634,349
Coin and check collecting box, combined, F. B. Many 634,359, 634,360
Compensator and railway signal, wire, N. Ratchford 634,273
Concrete mixer, S. P. McKelvey 634,416
Conduit pipe, A. S. Dixon 634,230
Cone adjuster and nut lock, F. G. Mott 634,090
Confectionery machine, H. B. Pinney 634,185
Conformator, E. Stahl 634,374
Cooler. See Milk cooler.
Cotton accumulator and conveyer, lint, J. W. Graves 633,996
Cotton cleaner and conveyer, seed, J. W. Graves 633,995
Cotton gin, J. W. Graves 633,993
Cotton gin, J. W. Graves 633,994
Couch, C. H. Grawitz 634,212
Counter, registering, C. H. Veeder 634,073
Coupling. See Car coupling. Pipe coupling. Thill coupling. Well drilling tool coupling.
Cradle, D. E. Morris 634,147
Crate or coop, folding, C. E. Rogers 634,031
Cuff fastener, C. M. Gidley 634,167
Cuff holder, H. C. & J. N. Guertin 634,133
Curtain construction, flexible, A. S. Spaulding 634,072
Curtain operating device, L. B. Smyser 634,189
Cushion. See Bottle case cushion.
Cutter. See Pie or cake cutter. Rotary cutter. Vegetable cutter.
Cycle, M. Matthews 634,062
Cycle speed changing gear, L. Stilmant 634,278
Cycle, spring, E. Harnett 634,340
Dental chair, A. P. Gould 634,084
Desk, school, S. W. Conwell 634,395
Diaper, L. J. Wolf 634,281
Die and tap holder, J. Nicklin, Jr 634,269
Disinfecting device, D. N. Hitchcock 634,109
Displaying device, shoe, D. S. Betcone 634,387
Displaying photographs, pictures, etc., device for, B. S. Whitehead 634,156
Ditching or excavating machine leveler, W. B. Doddridge 634,166
Doll, R. M. Hunter 634,143
Door fastener, R. Oehring 634,181
Door hanger, S. Thompson 634,041
Doubler for plates or sheets, J. H. Gill 634,293
Draught and temperature regulator, O. L. Badger 634,257
Draw bar attaching means, H. H. Sessions 634,219
Drier. See Clothes drier. Mechanical drier.
Drying various materials, F. D. Cummer 634,200
Drill. See Pneumatic hand drill. Seed drill.
Drilling machine, M. Gans 634,331
Drilling machine, portable electrical, A. L. Croneau 634,165
Dye and making same, blue black tetrazo, Levinstein & Herz 634,009
Egg tester, A. Thomass 634,249
Electric sparking, method of and means for preventing, Buckingham & Germann 634,198
Electric switch, W. Ely 634,057
Electric switch or signal apparatus, F. Andrews 634,226
Electric traction, system for power transmission for, E. Bede 634,258
Electrical conduit or tube, flexible, E. T. Greenfield 634,169
Elevators, base chamber or seat for hydraulic, R. S. Moore 634,119
Elevators, electric signaling apparatus for, S. D. Collett 634,229
Elevators, electric signaling apparatus for. Smalley & Reiners 634,220
Elevators, electric signaling device for, C. G. Armstrong 634,227
Enamel, translucent, W. & W. B. Lutwyche 634,117
End gate fastening, wagon, T. L. Myers 634,121
Engine. See Air compressing engine. Mining engine. Pulp engine. Rotary engine.
Engines, electric igniter for gas, W. H. Cotton 634,430
Engines, mixing device for gasolene, J. W. Lambert 634,242
Envelop, adjustable, W. M. Lambert 634,115
Evergreens, machine for winding, H. G. Wittbold 634,050
Exercising apparatus, W. J. Bryon, Jr 634,080
Extension table, C. N. Smith 634,372
Extractor. See Lemon juice extractor.
Feeder and purifier, boiler, F. Pye 634,272
Feeder for steam boilers, automatic water, Hanthorn & Welch 634,339
Fender. See Car fender. Flag fender.
Fibers, composition of matter for use in extracting vegetable, W. Warburton 634,154
File box, F. Macey 634,061
Filter, E. A. Leland 634,060
Filter, water, A. Kenney 634,113
Firearm, A. W. Savage 634,034
Fire cracker, L. Nordlinger 634,180
Fire cracker bodies, etc., choking machine for, G. Lispenard 634,176
Fire cracker body tubes, machine for making, Curtis & Lispenard 634,202
Fire cracker choke, C. L. Curtis 634,203
Fire cracker choke, G. Lispenard 634,177
Fire cracker choking machine, C. L. Curtis 634,201
Fireproof floor and ceiling slab, G. Fugman 634,262
Flag fender, W. Hart 634,140
Furnace. See Boiler furnace. Roasting and oxidizing furnace.
Furnaces, air feeding apparatus for boiler, J. Howden 634,348
Furrow opener, W. Y. Harding 634,239
Game, H. T. Hendy 634,141
Gas generator, acetylene, D. M. Dorman 634,401
Gas generator, acetylene, C. E. Wake 634,075
Gas generator, acetylene, P. D. Wescott 634,434
Gas generator, acetylene, C. L. Zimmerman 634,319
Gas lighting attachment, F. Billingham 633,983
Gas motor, Mollet-Fontaine & Letombe 634,063
Gate. See Swing gate.
Gate, O. B. Jacobs 634,351
Gate, J. H. Mahan 634,010
Gate, R. J. Parker et al 634,066
Gear, driving, J. W. & W. W. Brereton 634,163
Generator. See Gas generator. Steam generator.
Girdle, bust, M. W. Comly 634,429
Glass worker's tool, P. Shaw 634,276
Glassware, furnace for fire finishing, W. Buttler. 633,985
Glassware mould, G. H. Gray 634,107
Globe holder, A. G. Snow 634,221
Gong ringing apparatus, L. J. Klemm 634,005
Grinding mill, O. J. Ziegler 634,052, 634,053
Gun breech mechanism, Hadcock & Murray 634,238
Gun mounting, machine, Buckham & Larsson 634,390
Gun mounts, swivel pivot and its bearing for, J. J. Clarke 634,261
Harp, H. Heymann 634,142
Head rest, A. P. Gould 634,085
Heater. See Water heater.
Heating apparatus, W. R. Addicks 634,126
Heel, cushion, W. A. Zickerman 634,435
Heel nailing machine, Gamble & Black 634,106
Hides or skins, machine for filling, E. E. Chain 634,325
Hinge and support for desk lids, F. W. Tobey 634,379
Hinge for awning blinds, separable, E. C. Quimby 634,369
Hinge for storm sashes, separable, E. C. Quimby 634,370
Hoe, H. Compton 634,393
Hoe, weeding, F. D. Williams 634,158
Hog trap and loading device, J. W. Harrelson 634,139
Hoof pad, Baldwin & Turnure 634,436
Hook. See Pail hook. Sheep hook. Skirt hook.
Hoop former, barrel, T. Johnson 634,172
Horseshoe, rubber cushioned, C. E. Galley 634,410
Hydrogen peroxid, apparatus for manufacturing, Rosenblum & Yarnold 634,093
Ice making apparatus, A. H. Hutchinson 634,350
Ice making, etc., apparatus for, A. Glasson 634,335
Ironing board, A. Deschambault 634,399
Ironing machine, shirt, J. W. & H. Sutcliffe 634,376
Jack. See Lifting jack.
Jar. See Preserve jar.
Joint. See Pipe joint.
Kiln fire mouth, W. M. Viall 634,223
Knot tying implement, J. P. Swift 634,152
Lamp, electric arc, A. Hamacek 634,085
Lamp, electric arc, C. Tepel 634,314
Lamp, electric arc, J. M. Willard 634,157
Lamp handling appliance, trainman's, R. H. Weiden 634,419
Lamp, hydrocarbon incandescent, F. C. Dellone. 634,432
Lamp, petroleum incandescent, D. S. Williams 634,125
Lantern globe lift mechanism, W. C. Winfield, 634,077, 634,078
Lantern globe raising mechanism, tubular, W. C. Winfield 634,076
Lantern lift mechanism, tubular, W. C. Winfield 634,079
Latch and lock, combined door, E. E. Nelson 634,365
Lathe grinder attachment, H. Dock 634,232
Lemon juice extractor, A. F. Groundman 633,997
Letter box, J. A. Kline 634,006
Lifting jack, J. Scharer, Jr 634,035
Lighting device, J. H. Kendle 634,004
Liquids to receptacles, apparatus for automatically delivering, Cameron & Commin 634,424
Lock. See Sash lock. Seal lock.
Lubricating cranks, P. Diehl 634,204
Lunch box, R. Raby 634,186
Mail bag catcher, J. Garbers 634,131
Mail crane, F. M. Edwards 634,405
Mail marking device, H. E. Waite 634,418
Mandrel for tube making machines, E. C. Truyter 634,191
Manhole junction box, J. W. Turner 634,381
Measure, interest, D. Strange 634,040
Measuring frictional resistances between bodies in sliding contact, apparatus for, A. B. Lawther 634,007
Mechanical drier, F. D. Cummer 634,199
Mechanical movement for gas engine valves, etc., J. B. Fenner 634,207
Medicament carrier, Jones & Harvey 634,354
Mercerizing apparatus, P. S. Marshall 634,362
Metal bars, etc., press for bending and straightening, W. J. Muncaster 634,245
Metal drilling machine attachment, W. E. Canedy 634,324
Metallic sheet for use in constructing buildings, G. Fugman 634,237
Milk cooler, E. G. Fullerton 633,992
Milk rack and refrigerator, A. M. Smith 634,070
Mill. See Grinding mill. Stamp mill.
Mill box, E. Andrews 634,320
Mining engine, B. Yoch 634,422
Mixer. See Concrete mixer.
Mop head, W. S. Harper 634,138

(Continued on page 254)

Motive power, method of and apparatus for generating, G. M. Westman	634,155
Music leaf turner, H. E. Swarts	634,279
Nest, hen's, R. E. Zearfoss	634,051
Nut lock washer, J. G. Waggoner	634,048
Nut locking washer, J. Walsh, Jr.	634,382
Nut setting machine, J. C. Poe	634,027
Oil burner, J. R. Duncan	634,288
Ores, electromagnetic apparatus for separating, E. Kreuser	634,356
Pad. See Hoof pad.	
Pail hook or corner iron, A. H. Gardner	634,290
Pan. See Prospector's pan.	
Paper bag machine, H. Bilgram	634,102
Paper bag machine, E. E. Claussen	634,081
Paper bag machine, R. M. Uhlmann	634,099
Paper box, F. Knobeloch	634,415
Paper making machine, Barrett & Horne	634,228
Paper making machines, apparatus for drying wet felts of, H. Neidhardt	634,307
Paper perforator, W. S. Mendenhall	634,304
Pen, fountain, D. C. Demarest	634,398
Pen, fountain, O. R. Mitchell	634,013
Pen, fountain, E. Reisert	634,029
Perforating machine feeder, C. S. Perkins	634,246
Phonographs, etc., diaphragm plate for, W. W Cridge	634,326
Phonographs, multiple mandrel attachment for, A. B. Robinson	634,025
Photographic plates, simultaneously developing and fixing, P. Hanneke	634,137
Piano, H. Ziegler	634,282
Piano string winding machine, Monighan & Brainard	634,266
Picture exhibitor, G. & J. Maddox	634,146
Picture frame hanger, Thompson & Allen	634,190
Pie or cake cutter, J. L. Gans	634,330
Pin. See Clothes pin.	
Pipe. See Conduit pipe.	
Pipe coupling, W. J. Henning	634,344
Pipe coupling, H. O. Kelsey	634,087
Pipe joint, drain or sewer, J. B. Hamilton	634,136
Pipes, box flange coupling for sheet metal, E. V. Schenck	634,275
Pipes, traps, etc., clean-out fitting for drain, F. Tudor	634,250
Pitman, Diehl & Muller	634,205
Planing, milling, or drilling, work holder for, J. F. Wilson	634,225
Plow attachment, D. V. T. Hubbard	634,086
Plow, gang or cultivator, J. T. Lucas	634,358
Plow vine cutting attachment, G. H. Nungezer	634,366
Pneumatic hand drill, C. T. Smith	634,071
Power transmitter, variable, L. M. Dieterich	634,327
Power transmitting mechanism, B. S. Lawson	634,174
Preserve jar and stopper, L. S. Hoyt	634,240
Prickly pear or cactus burner, J. S. Ellison	634,130
Printed matter, cutting apparatus for sheets containing E. A. Henkle	634,342
Printer's furniture, A. Paterson	634,021
Printer's overlay and making same, Bierstadt & De Vinne	634,259
Printing in several colors, machinery for, E. Lambert	634,144, 634,145
Printing machine perforator, web, R. C. Annand	634,255
Printing press, J. A. Svensson	634,311
Propeller, screw, T. Pounds	634,368
Propulsion, means for marine, J. A. Secor	634,217
Prospector's pan, W. H. Moore	634,120
Pulley, clutch, T. J. O'Brien	634,367
Pulley, divided, W. A. Clark	634,260
Pulley rims, die for forming sheet metal, E. G Budd	634,284
Pulp engine, S. S. Stevens	634,038, 634,039
Pulverizer, R. Yates	634,254
Pumping jack gearing, W. C. Woodward	634,194
Punching register, C. Berst	633,982
Rack. See Clothes rack. Milk rack.	
Radiator, wrought metal, F. A. Wilmot	634,317, 634,318
Railway signal, W. S. Boult	634,388
Railway signal, J. Sargent	634,187
Railway signal, electric, T. H. Patenall	634,023
Railway sleeper and chair, combined, H. E. Rooke	634,032
Railway switch, J. E. Peter	634,309
Rake, J. Steers	634,310
Recorder. See Time recorder.	
Reflector, incandescent lamp, W. Goodchild	634,295
Register. See Punching register.	
Retort for carbonizing wood, W. H. Bowers	634,161
Return feed device, A. Conkling	633,988
Roasting and oxidizing furnace, A. Ropp	634,247
Roofing, J. Blocher	633,984
Rotary cutter, G. D. Gillette	634,210, 634,211
Rotary engine, P. Kabellek	634,002
Running board, vehicle, J. B. Thacher	634,378
Saccharine solutions, apparatus for treating, H P. Dyer	634,233
Sack holder, F. H. Gilbert	634,334
Saddle support, adjustable, C. S. Smith	634,096
Sash lift and lock, D. Gardner	634,332
Sash lock, A. P. Heidt	634,213
Sash lock, J. L. Oefinger	634,020
Sash, swinging window, Weingaertner & Shumate	634,384
Sash temporary support, window, T. O'Shea	634,308
Saw guide, F. J. Drake	634,206
Saw tooth swaging machine, Butts & Dumbeck	634,164
Scale, platform, M. H. Winslow	634,420
Scale, portable weighing, W. S. Bracktle	634,162
Seal lock, J. H. Harvey	634,411
Seals, machine for reopening bottle, T. J. Henderson	634,412
Seat, J. James	634,352
Seat post clamp, W. H. Fauber	634,058
Seed drill and horse hoe, T. E. Martin	634,178
Sewage, process of and apparatus for treating, D. Cameron et al.	634,423
Sewage treating apparatus, D. Cameron et al, 634,425 to	634,428
Sewing machine, buttonhole, J. Gutmann et al, 634,134,	634,135
Sewing machine, hemstitch, C. H. Foster	634,208
Shade bracket, adjustable window, D. M. Miller	634,179
Shafts, mechanism for operating intermittingly rotating, H. W. Porter	634,068
Sheep hook, P. I. Moule	634,364
Sheet metal package, R. C. Russell	634,033
Shelf bracket and support therefor, W. H. Newlee	634,091
Shells, buffer for high explosive, T. R. R. Ashton	634,101
Ships' hulls, apparatus for cleaning, W. P. Freeman	634,328
Ships' hulls, diver's stage for cleaning, W. P. Freeman	634,329
Shirt bosom adjuster, A. D. Murray	634,317
Sifter, rotary ash, A. Haenichen	634,263
Sign, C. C. Whelan	634,316
Signal. See Railway signal.	
Signal board, train order, W. Nichols	634,268
Signal system, danger, W. Mayes	634,118
Skein holder, G. Fishback	634,235
Skins, preserving and tawing, U. de Gunzburg	634,337
Skirt and belt supporter, A. M. Tully	634,380
Skirt hook, R. J. Fisher	634,105
Skirt supporter, G. L. Blackman	634,196
Sled, E. Morgan	634,267
Slide, sheet metal, J. F. Molloy	634,014
Snow or ice into water, device for converting, E. S. Palmer	634,021
Snow plow and dumping cart, combined, M. J. F. Scanlan	634,274
Sole, H. Marlow	634,361
Spike, S. W. Higgins	634,413
Spool holder, M. C. Hromas	634,000
Spring for carriage cushions, beds, etc., Teeter & Sly	634,313
Stamp, hand, L. K. Scotford	634,371
Stamp mill, Pratt & La Grave	634,417
Starching machine, W. Hess, Jr.	634,346
Steam boiler, D. P. Jones	634,299
Steam generator, G. W. Shields	634,277
Stem making machine, combustible, Bidwell & Curtis	634,195
Stool and foot rest, store, J. W. Smith	634,373
Stoves, etc., grate for cooking, J. E. Keyt	634,414
Street sweeper, G. W. Braky	634,283
Stringed instrument, J. Brandt	634,103
Stringed instruments, automatic fingering device for, Scott & Brown	634,124
Swimming apparatus, F. H. B. Babbe	634,128
Swing gate, J. H. Hannay	634,338
Swinging chair, H. J. Ritter	634,030
Switch. See Electric switch. Railway switch.	
Switch, Braley & Custer	634,437
Syringe, A. L. Henry	634,108
Table. See Extension table.	
Tag, changeable address, A. W. Askew	634,159
Tagging plug tobacco, machine for, J. V. Bohannan	634,321
Thill coupling, H. A. Luttgens	634,116
Threaded articles, apparatus for manufacturing, F. T. Giles	634,209
Threshing and separating machine, grain, G. B. Sellers	634,148
Ticket case, L. W. T. Lodge	634,244
Tie. See Cattle tie.	
Tile decorating apparatus, T. Holt	634,171
Tile, illuminating, P. Briganti	634,054
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(Continued on page 255)

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